Journal of the Society of Arts.

FRIDAY, FEBRUARY 12, 1858.

DEPUTATION TO HIS ROYAL HIGHNESS THE PRESIDENT.

A deputation of Members of the Society of Arts, and of Presidents of the Institutions in Union, attended at Buckingham Palace on Thursday, the 11th inst., at 3 o'clock, to present a congratulatory address to His Royal Highness the Prince Consort, President of the Society, on the occasion of the marriage of Her Royal Highness the Princess Royal with His Royal Highness Prince Frederick William of Prussia.

The address, which was signed by upwards of ten thousand Members of the Society of Arts and of the Institutions in Union, was read by Mr. C. Wentworth Dilke, Chairman of the Council.

To His Royal Highness the Prince Consort, President of the Society for the Encouragement of Arts, Manufactures, and Commerce.

We, the undersigned Members of the Council, and Members of the Society for the Encouragement of Arts, Manufactures, and Commerce, and of the Institutions in union therewith, desire to present to your Royal Highness our heartiest congratulations upon the marriage of Her Royal Highness the Princess Royal with His Royal Highness Prince Frederick William of Prussia; and we sincerely hope that the fullest happiness will attend this union.

The long period of fourteen years, during which the Society of Arts has enjoyed the active Presidency of your Royal Highness, will, we trust, justify our seeking this opportunity to express our sense of the deep obligation which the Arts, Manufactures, and Commerce of the United Kingdom owe to your Royal Highness, for the constant and discriminating attention and the judicious acts by which you have promoted their progress.

We feel that the marriage of Her Royal Highness the Princess Royal with the Prince of a great Country so much like our own as Prussia, in the love of Arts, Science, and Industry, must tend to promote international friendship, and so extend and secure to both countries the peaceful and beneficent objects for the encouragement of which our Society is instituted.

These objects, we believe, form the soundest basis upon which the material interests of Nations can rest for advancing their political liberties, their commercial prosperity, and their social happiness.

The reply of His Royal Highness, the President, was as follows:—

I beg you to accept my warmest thanks for your kind congratulations on the marriage of my beloved eldest daughter with Prince Frederick William of Prussia.

This union, which, from the education and personal character of the young Prince, promises to secure the permanent happiness of our dear child, could not but fill the hearts of both the Queen and myself with joy, and with thankfulness to Almighty God; but we have derived additional satisfaction and pleasure from the universally expressed sympathy, and participation in our joy, by the nation at large.

That this sympathy should be re-echoed by your Society, which, during fourteen years has commanded my best wishes, and any feeble assistance which I could render to it, must be most gratifying to me.

Gentlemen, these fourteen years, which have seen my daughter grow up from an infant, to become a married wife, transferred to a high sphere of usefulness in a foreign land, to which our most tender affection must still follow her, have also seen children of yours,—I mean the many plans and schemes for the promotion of Art, Science, and Industry which you have originated,—develope themselves, and grow up into independent life and power. Some of these have attracted the admiration of the world, whilst you could only follow them from a distance, with the fond eye of a parent who finds his highest gratification in the success of his offspring.

I am glad to find you accompanied on this occasion by the Deputations of the many Institutions throughout the country with which you have placed yourselves in union, and to have this opportunity of expressing to them my strong sense of the usefulness of their exertions for the promotion of the Education of the Adult Classes in this country. I trust they will at all times freely bring the result of their varied experience to the knowledge of the Society, to which suggestions coming from them must naturally be most valuable.

The undermentioned gentlemen composed the deputation, and had the honour of being presented to His Royal Highness by the Chairman of the Council:—

E. Akroyd, M.P., President, Haley-hill Working Man's College.
J. D. Allcroft.
J. G. Appold, F.R.S., Auditor.
Chas. Atherton.
Dr. Herbert Barker, Hon. Local Secretary.
Rev. John Barlow.
J. A. Beaumont, President, Beaumont Philosophical Institution.
Booker Blakemore, M.P.
Charles Bleeck, Pres., Warminster Athenæum.
W. H. Bodkin.
W. P. Bodkin, Highgate Literary and Scientific Institution.
H. G. Bohn.
Beriah Botfield, M.P., F.R.S.
Antonio Brady.
John Braithwaite.
William Bride, Mayor of Yeovil, Pres., Mutual Improvement Society, Yeovil.
Captain Bulkeley, Pres., Literary and Scientific Institution, Windsor.
C. S. Butler, M.P.
W. Button, President, Lewes Mechanics' Institution.
James Caird, M.P.
Lord Carnarvon, President, Newbury Literary Inst.
F. S. Cary.
Edwin Chadwick, C.B.
William Challinor, President, Leek Literary Inst.
Dr. Chambers, Member of the Council.

R. L. Chance, President of the West Bromwich Inst.
Harry Chester, Vice-President.
Dr. Chowne.
John M. Clabon, President, Kingston-on-Thames Literary and Scientific Institution.
Rev. S. Clark.
John Clutton.
A. Claudet, F.R.S.
A. Coleman, President, Wandsworth Literary Inst.
W. Fothergill Cooke.
James Coombs, Pres. Bedford Lit. and Scientific Inst.
Dr. Copland.
Samuel Courtauld.
Thomas R. Crampton.
George Critchett.
H. D. P. Cunningham.
William Curtis, President, Alton Mechanics' Institution.
John Darlington, Hon. Local Sec.
J. C. Deane.
Warren de la Rue.
Thomas de la Rue, F.R.S.
Thomas Dickins.
John Dillon.
Henry Doulton.
M. H. Drury, Haley-hill Working Man's College, Halifax.
J. A. Dunn, Pres. London Tailors' Labour Agency Literary Institute.
Col. Eardly-Wilmot, R.A.
Lord Ebury.
Henry Edwards, President, Lynn Athenæum.
William Ellis.
William Fairbairn, F.R.S., Member of Council.
Dr. Farr.
R. T. Fauntleroy.
Joseph Fenn.
Robt. Fisher.
W. M. Fladgate.
Benjamin Fothergill.
John Fowler.
F. F. Fox, President, Melbourne (Derbyshire) Mechanics' Institution.
J. Griffith Frith, Member of Council.
T. H. Galton, President, Bromsgrove Literary and Scientific Institution.
Thomas Garfit, President, Boston Athenæum.
Richard Garrett, President, Leiston Mechanics' Institution.
J. P. Gassiot, V.P.R.S.
Thomas Field Gibson, F.G.S.
J. W. Gilbart, F.R.S., Member of Council.
William Gladstone, President, Highgate Literary and Scientific Institution.
Joseph Glynn, F.R.S., Vice-President.
F. Godrich, President, West Brompton Literary and Mutual Improvement Institution.
George Godwin, F.R.S.
Daniel Gooch, President, Great Western Railway Literary Society.
Peter Graham, Member of Council.
G. Greatorex, President Ashbourn Literary Institution.
Stephen Green.
Rev. C. Stroud Green, President, Lewes Impt. Asso.
Alfred Gyde, President Painswick Mechanics' Institution.
F. S. Haden.
S. C. Hall.
William Hamilton, R.N., President, Portsmouth and Portsea Literary and Philosophical Society.
Rev. J. H. Hamilton, President, Pimlico Literary, Scientific and Mechanics' Institution.
W. Parker Hammond, F.R.A.S.
Michael Hanhart.
G. W. Harris, President, Halstead Literary and Mechanics' Institution.
Charles Hart.
Rev. Henry Hawkes, President, Portsea Athenæum and Mechanics' Institute.
John Hawkshaw, F.R.S.
Henry Heane, President, Newport (Salop) Mechanics' Institution.
Rev. Lord Arthur Hervey, President, Bury St. Edmund's Athenæum.
Samuel Hickson.
Edward Highton, C.E.
J. Hixon, President, Holmfirth Mechanics' Institution.
Herbert M. Holmes, Hon. Local Secretary.
J. Holmes.
William Hooper.
Henry T. Hope.
R. Hopwood, President, Staley-bridge, Mech. Inst.
Rev. Dr. Hume, Hon. Local Secretary.
W. Burnley Hume.
Robert Hunt, F.R.S.
Rev. J. Hutchinson, President, Berkhampstead Mechanics' Institution.
S. B. Hutt, President, Cambridge Mechanics' Institute.
Captain Ibbetson, F.R.S.
Wotton Isaacson, President, Huntingdon Literary Inst.
W. S. Jackson, President, Shropshire Mechanics' Inst.
T. H. Jennens.
Henry Johnson.
Owen Jones.
Henry L. Keeling.
Wilhelm Klein, President, Red Hill Institute.
Alfred Lapworth.
J. R. Lavanchy.
Frederick Lawrence.
Rev. Charles Lee, President, Bilston Institute.
John Leighton, F.S.A.
Professor Leone Levi.
Stephen Lewis.
Dr. Waller Lewis.
W. S. Lindsay, M.P.
E. T. Loseby.
George Lowe, F.R.S.
Rev. Charles Mackenzie.
William Mackrell, Auditor.
Lord George Manners, Pres. Newmarket Lit. Inst.
John Manning, Pres. Cambridge Philo-Union Lit. Soc.
Horace Martin, Pres. Battle Mechanics' Institution.
C. P. Matthews, Pres. Romford Lit. and Mech. Inst.
Taverner John Miller, M.P.
N. Montefiore, President, London Jews and General Literary and Scientific Institution.
G. F. Morrell.
T. N. R. Morson.
William Mulready, R.A.
Andrew Murray, Pres. Portsea Watt Institute.
George Myers.
Dr. Nairne.
Henry Newall, Honorary Local Secretary.
J. A. Nicholay.
Matthew Noble.
J. S. Noldwritt, President, Literary and Scientific Institution, Walworth.
Professor Owen, F.R.S.
Thomas Page.
Sir John S. Pakington, Bart., M.P.
Philip Palmer.
General Sir Charles Pasley, K.C.B.
Henry Pease, M.P., President, Darlington Mechanics' Institution.
George Peel, Hon. Local Secretary.
Apsley Pellatt.
J. H. Pepper.
R. M. Perkins.
Robert Phillips.
Sir Thomas Phillips, Member of Council.
W. H. Pilkington, President, Clayton-le-Moors Institute.
Dr. H. Porter, President, Peterboro' Mechanics' Institute.
Dr. Spencer Pratt, President, Stamford Institution.
C. A. Preller.
John Procter.

Dr. Prior Purvis, President, Greenwich Useful Knowledge Society.
J. Allan Ransome.
Charles Ratcliff, Hon. Local Secretary.
Robert Rawlinson.
Alexander Redgrave.
Sir John Rennie.
Dr. Roget.
J. Rooker, President, Bideford Literary and Mech. Inst.
William Roupell, M.P.
J. Scott Russell, F.R.S., Vice-President.
J. Russell.
Arthur Ryland, Pres. Birmingham and Midland, Inst.
Bishop of St. Davids.
Thomas Sanctuary, President, Horsham Literary and Scientific Institution.
Sir H. P. Seale, Bart., President, Dartmouth Literary Institution
Major Scoones, President, Society of Literary Enquirers, Tunbridge.
W. B. Simpson.
Sir George Smart.
Sidney Smirke.
J. Jobson Smith.
James Snow, Pres., Lincoln Mechanics' Institution.
R. T. Spiers, Honorary Local Secretary.
J. R. Stebbing, President, Southampton Polytechnic Institution
Colonel W. H. Sykes, M.P., F.R.S.
R. W. Tamplin.
John Thimbleby, President, Barnet Institute.
Rev. T. Thomas, President Wellingborough Mechanics' Institution.
G. S. Tolson, President Huddersfield Mechanics' Inst.
Charles Towneley, President Burnley Mechanics' Inst.
Matthew Uzielli.
Cornelius Varley.
S. Waley.
J. H. Watherston.
Daniel Watney, jun.
W. Westley.
The Marquis of Westminster.
James Whatman, M.P.
Heywood Whitehead.
Josiah Wilkinson.
G. F. Wilson, F.R.S., Member of Council.
Thomas Winkworth, Vice-President.
F. A. Winsor.
Pres. Mechanics' Institute, Wisbech.
W. Wood, M.P.
M. Digby Wyatt.

P. Le Neve Foster, *Secretary.*
Charles Critchett, *Assistant Secretary.*
S. T. Davenport, *Financial Officer.*

TENTH ANNUAL EXHIBITION OF INVENTIONS.

Monday, the 5th of April, is fixed for the opening of the Society's Tenth Annual Exhibition of *recent* Inventions.

Persons intending to contribute to the Exhibition should communicate with the Secretary of the Society of Arts as soon as possible, stating—

1. The title of the Invention.

2. Whether the article will be a Specimen, Model, or Drawing.

Articles for exhibition must be forwarded to the Society's House, Adelphi, London, W.C., *carriage paid.*

The days for receiving articles are, Thursday, the 18th; Friday, the 19th; and Saturday, the 20th of March; and no articles can be received after the last of these days.

All articles should be accompanied with a brief but clear description of the invention, with a wood-block (when possible) for illustrating the Catalogue, and a reference to any publication in which the Invention is described.

All drawings exhibited must be framed.

ARTISTIC COPYRIGHT.

A Report as to the existing English Common and Statute Law, relative to this subject, has been prepared at the request of the Committee, by D. Roberton Blaine, Esq., Barrister-at-Law, Reporter to the Committee, and may be obtained of the Society's publishers, Messrs. Bell and Daldy, Fleet-street. Price Sixpence.

SPECIAL PRIZE.

A Prize of Twenty Pounds (placed at the disposal of the Council for this purpose by the Rev. F. Trench and J. MacGregor, Esq.,) and the Society's Silver Medal, is offered for a Writing-case suited for the use of Soldiers, Sailors, Emigrants, &c. The attention of those intending to compete for this prize is directed to the following points, which will influence the Council in making their award :—

Lightness,
Smallness of size,
The avoidance (if possible) of fluid ink,
Durability,
Cheapness, with a guaranteed supply, and
General applicability to the duties, habits, and requirements of the above classes.

The articles sent in for competition must be delivered at the Society's House, Adelphi, London, W.C., on or before the 8th May next.

EXAMINATION PRIZE FUND FOR 1858.

The following circular letter has been addressed to the Members of the Society :—

Society for the Encouragement of Arts, Manufactures, and Commerce, Adelphi, London, W.C., Jan. 30, 1858.

SIR,—I am instructed by the Council to inform you that the Examination Prize Fund for 1858 is now opened. The donations for 1857 were contributed by twenty-three Members, and there is a small balance to carry forward.

The Council draw attention to the fact, that last year's Examinations were limited to two centres. At these two centres, pupils from thirty-seven Institutions only presented themselves; ten of them were from the metropolitan district, London being one centre; sixteen from Yorkshire, Huddersfield being the second centre, leaving but eleven for all England, Ireland, Scotland, and Wales. This unequal distribution was one of the reasons which satisfied the Council that the system was not adapted to meet the wants of all the Institutions. They, therefore, resolved to bring the Examinations to the very doors of

the Institutions, by such step of course throwing open the prize fund to the students of every Institution.

The Council have also decided on contributing a certain mileage towards the travelling expenses of those candidates who desire to receive personally and publicly their prizes, and also £5 towards the travelling expenses of each pupil, who, obtaining three of the Society's certificates of the first class in the subjects contained in the Oxford programme, is desirous to contend for the degree of Associate at the Oxford Examinations. These changes lead the Council to believe that a considerably larger sum than last year will be required for the prizes, and I am, therefore, instructed to draw the attention of all the members to the circumstances.

Donations can be remitted to Mr. Samuel Thomas Davenport, Financial Officer, Society of Arts, Adelphi, London, to whom Post-office Orders should be made payable.

I am, Sir, your obedient servant,
P. LE NEVE FOSTER, Secretary.

The following is the list of Donations up to the present date :—

	£	s	d
T. D. Acland, Member of Council		5	5
J. G. Appold, Auditor		10	10
Harry Chester, Vice Pres.		10	10
Henry Cole, C.B., Vice Pres.		1	0
C. Wentworth Dilke, Vice Pres., Chairman of Council (third donation)		10	10
Thomas Dixon		1	1
Lieut.-Col. F. Eardley-Wilmot, R.A.		5	0
Lord Ebury		5	0
J. Griffith Frith, Member of Council		5	5
J. W. Gilbart, F.R.S., Treasurer (second donation)		10	10
F. Seymour Haden (annual)		2	2
Edward Highton (annual)		2	2
James Holmes (annual)		1	1
The Marquis of Lansdowne, Vice Pres.		20	0
The Master of the Mint, Member of Council (second donation)		10	10
Sir Thos. Phillips, Member of Council		5	5
Arthur Trevelyan		1	0
T. Twining, jun., Vice Pres.		10	10
Dr. J. Forbes Watson		1	1
G. F. Wilson, F.R.S., Member of Council (third donation)		10	10

EXAMINATIONS.—LOCAL BOARDS.

The following circular has been issued by the Central Committee of the Yorkshire Union, to the Institutions included in it :—

Central Committee, Mechanics' Institution,
Leeds, January, 1858.

DEAR SIR,—We have the pleasure to inform you that arrangements are being made for the formation of Local Boards of Examination of Candidates for the Certificates of the Society of Arts, at the following places :—

Leeds.	Wakefield.	Hull.
Bradford	Sheffield.	Selby.
Halifax.	Middlesborough.	York.

The Examiners will meet in Easter week for the preliminary examination of the Candidates whose names will be forwarded to the Council of the Society of Arts in London, and printed Papers of Questions will be sent for the final Examinations of the Candidates, to take place in the week commencing Whit-Monday, 24th May.

The Examinations, which will comprise the subjects detailed in the Programme published by the Society of Arts, will be open to such Institutions as may desire to associate themselves with the Institutions where the Examinations are appointed, and each Institution so associated will be at liberty to send a representative to the Board of Examiners.

Should any of the members of your Institution be desirous of becoming candidates, you will please to communicate as early as possible with the Secretary of the Institution which you may deem the most convenient locality for your members to attend; or, if you prefer it, we shall be happy to become the medium of communication.

We are, Dear Sir, Yours truly,
EDWD. BAINES, President.
JAMES HOLE, } Hon. Secs.
JAS. KITSON, Jun., }

COUNCIL MEETING.

Acting under the provisions of the Society's Bye-Law No. 74, the Council have elected His Majesty the King of Siam an Honorary Member of this Society.

TENTH ORDINARY MEETING.

WEDNESDAY, FEB. 10, 1858.

The Tenth Ordinary Meeting of the One Hundred and Fourth Session, was held on Wednesday, the 10th inst., William Fairbairn, Esq., F.R.S., in the chair.

The following Candidates were balloted for and duly elected members of the Society :—

Acworth, Rev. Wm.	Little, Thomas
Austin, Henry	Seguier, Frederick Peter
Brunlees, James, C.E.	Watton, William

The following Institutions have been taken into Union since the last announcement :—

454. Burnley, Mechanics' Institution.
455. Ashford, Mechanics' Institution.

The Paper read was :—

ON THE APPLICATION OF STEAM POWER TO THE CULTIVATION OF THE SOIL.

By J. ALGERNON CLARKE.

Steam-power having been successfully applied to what may be called the mill-work of the farm, such as threshing, cutting, slicing, grinding, pulping, and preparing the various products and "feeding stuffs," entering into the economy of the farmyard, I take the present subject to be confined to operations in the field; including drainage, preparatory tillage of all kinds, sowing, weeding, reaping, cartage of produce to suitable storing places, and the distribution of manure. And, lest a paper on these topics should extend to an unmanageable length, it will be advisable to be still more restricted, so that, waiving for the present a consideration of draining, manuring, sowing, and the light after-processes of tillage, I come to the first operation of breaking up the soil, and the mechanical preparation of a seed-bed as the main objects to be accomplished in steam cultivation.

Mr. Hoskyns, whose original views of this subject have moulded the designs of many inventors, and first fully awakened the agricultural world to the importance of steam-culture, teaches us to look beyond our familiar digging, ploughing, harrowing, scuffling, and rolling, as the sole possible modes in which the new motive-power may operate. We should analyse these processes; see what is the end attained by them, and then endeavour to accomplish the desired result with a machine as specially adapted to steam-power, as the present horse and

hand implements are to animal-power. Investigating the nature of preparatory tillage, he finds it to consist in "comminution, aeration, and inversion," which it is possible to effect at once, in a single act, and with a simply-formed tilling instrument; and from the fact of horse-traction being horizontal, manual delving vertical, and the "favourite motion" of machine-work circular, he concludes (with an amount of argument and illustration which establishes and fortifies his deductions,) that some kind of "revolving cultivator" will ultimately be found best for being driven by a steam-engine. Accordingly, I am prepared to offer what, I believe, to be a new principle of rotary digging by steam-power, calculated to fulfil the various conditions recommended by theory or demanded by practice; but as an essay solely on mechanical tillage, so far advanced and a-head of the times, would be of little more immediate practical value than a history of past attempts and failures, I will first consider the application of steam-power to our existing order of implements.

At the outset let me remark that, although the "favourite motion" of steam machinery is circular, this is no valid reason why we should reject without trial every other kind of motion if suited to our purpose, seeing that the steam-engine employs rectilinear motion, continuous and reciprocating, and, indeed, all conceivable varieties of movement adapted to specific ends; and of all practical trials yet made, with the exception, perhaps, of Mr. Romaine's cultivator, far more favourable results have followed from applying steam-power to the haulage of traction implements, than from setting it to drive revolving cultivators. The wonderful rapidity with which steam-thrashing has been accomplished, is owing to the circumstance that there was really nothing new to do; the engine had to turn a sheave (to thrash a sheaf) by means of a driving belt, just as it was accustomed to do in thousands of factories, only it had to be made portable. But working over so great an area as the surface of a field is a novel operation for the steam-engine, beyond the mere application of cogwheels, shafting, belts and brasses; and there is difficulty enough in finding how to apply the motive-power at all points of the surface in succession without staying to devise, in addition, more perfect tillage implements than we now possess.

To draw an implement such as the plough, which has been tested, improved, and adapted throughout many centuries, is a simpler and readier problem than to contrive a new description of tool for performing a hitherto unknown operation, involving, perhaps, a novel system of cultivation altogether; and as in thrashing, the implement will doubtless be speedily improved when once the new power has been applied to it. Again, there is no doubt that intelligent farmers everywhere are prepared to work traction implements by steam, whenever they are convinced that the present ploughing, scarifying, &c., can be done at less cost, all things considered, than by horses. A steam-plough is capable of instant and universal adoption, while a new tilling machine would not only meet with mechanical difficulties, but be a long time in achieving practical and pecuniary success against customs and prejudices cherished for generations. It will be wise to imitate those processes which are now found to produce the best effects, even though this may not be making the most advantage of the power that is possible.

In practice it is found indispensable that the staple of the land should be occasionally inverted—to bury surface weeds, stubble, sward, or manure, and bring up root weeds for extraction; also to fertilize the soil by the chemical and mechanical effects which follow both the exposure of earth that has lain long buried, and the burial of that which has been long treated by rains, dews, winds, frosts, and sunshine. This inverting, indeed, may be said to constitute the heaviest labour of tillage; if we can perform this, we can readily master any after-stirring or pulverization. Breaking-up, without inversion, is getting into favour; but experience at Lois-Weedon and elsewhere shows that a tenacious subsoil should be exposed and weathered before being mingled with the staple. Mere granulation by scratching or rasping, mingling rather than turning over the mass so comminuted, has been proposed as the ideal operation we should aim to accomplish; but, however useful it may prove in some cases, I cannot regard it as calculated to meet all the necessities of our present practice, in which we find that, after certain crops and for various purposes, the soil must be cut or broken into pieces sufficiently large and tenacious to be turned bodily upside down. The pick or mattock may be a valuable tool in some countries—working with a minutely pulverising effect, and, at the same time, securing a more or less complete inversion—and the plough itself is in some climates a mere grubbing or ribbing tool; but with our moist soils and weeping atmosphere, our principal implements for performing the fundamental process of cultivation have been of necessity the plough that turns a furrow slice, and the spade that cuts and completely turns over a spit, the plough modified into many shapes, and the spade or fork made equally versatile in its adaptation to deep, shallow, light, strong, or stony land. Of these two implements the plough can be more easily actuated by steam-power than the spade: all hand tools being worked by several different motions intermittent and irregular, and so requiring complicated mechanism to imitate their action, while traction implements, moving with a continuous rectilinear motion, have simply to be drawn along, and with but little modification needful in their present form; hence, the solution of the steam-culture problem lying nearest to us consists in

Steam Ploughing.

On light land, and where shallow work alone is required, the breaking up and inversion of the soil is done with great efficiency by the plough; and when we see the neatness with which leas are "tucked down" by our first-class skim-coultered ploughs, precisely that toughness being left in the slice which is so desirable on such land, we cannot think that any better implement need be there desired. On heavy land, where tillage makes a larger item in the expenses of management, and a cheaper motive power than that of horses will prove the greatest boon, the plough seems to be used merely because the horses cannot dig. The sledging sole does harm; the slices, not sufficiently subdivided, harden and make work for future dragging and reducing; and inversion is imperfectly effected, because a "harrow-edge" is necessary for securing a good "mould." Deep culture is also needed on most strong lands; yet, the farther we dig below the surface, the more is our horizontal traction at a disadvantage. A vertically descending tool appears to be required rather than a horizontally drawn one; and, perhaps, rotary diggers will ultimately be found as peculiarly adapted for penetrating and stirring up the subsoil from great depths, as traction implements are for tilling the upper stratum. Such lands will be grateful for a digging or trenching machine driven (not dragged) by a steam engine, whenever it is practically brought to the field. Meanwhile, the most effective implement for deep work on a large scale, in which manual digging is precluded, is the plough, with the subsoiler or trench-plough following. However, in spite of Lois Weedon husbandry, and the larger experience of the Yester farms, deep tillage is not so much sought after at present as a more rapid and economical method of performing ordinary ploughing. Instead of the slow trenching machine (although necessary to the renovation of clay-land farming), everybody is asking for steam machinery that can plough or equally well cultivate, at comparatively small cost, a great area of ground in a little time.

Steam-ploughing is not only possible, but is being actually done on a considerable scale; and, without re-

citing the long history of inventions for the purpose, I wish to consider the various plans now before the public —the results as far as yet ascertained, and then to make suggestions for further progress.

The first point is—How to apply the power to the implement? and the next is, the construction of the plough or ploughing machine.

As the material to be cut and turned over cannot be "fed" to our machine, we must take the machine over every part of the surface to be acted upon. Is the motive power then to be transported bodily over the whole area, as horses are, or is it to be transmitted from a distance? The idea of a locomotive power was the earliest, and certainly the most natural, from observing horse-labour, besides being a corollary from the invention of steam-carriages. And though it may at first sight seem ridiculous to harness an engine to an implement, as though its strength, like that of a horse, lay in its legs, yet we have the example of the railway locomotive, which exerts all its power by means of its (rotary) legs, yokes itself in front of a carriage, and pulls with traces, as a horse does. Working on a level and smooth roadway, the locomotive can drag a train of carriages more economically than a stationary engine can haul it with rope; and, allowing for the difference between a galloping railway speed and the sluggish pace required on an arable field, analogy would lead us to expect a like superiority of the locomotive, whether in pulling ploughs or vehicles. I need not enumerate all the attempts at locomotive engines for traversing arable land, but shall notice two only, one "theoretical," the other practical.

The great weight of a steam-engine, with its water and coal, forms the chief obstacle to its transit over a soft or rugged surface; why not, therefore, employ a pneumatic locomotive? In 1839, Mr. Henry Pinkus patented a most ingenious method of applying an atmospheric vacuum, or else compressed air, as an auxiliary for conveying motive-power from a stationary engine to travelling implements. Now, without adopting his proposal of laying down air main-pipes about an estate, and distributing power (as Mr. Mechi does manure) from steam-pumps at the central homestead, might we not take his plan for connecting a light travelling pneumatic engine with air-pumps attached to a stationary portable steam-engine? A flexible tube, coiled on a cage-drum upon the pneumatic locomotive, is paid out as the locomotive recedes from the steam-engine, and wound up as it approaches. By passing and repassing the steam-engine, a length of 200 yards may be ploughed with only half that length of pipe, and as this is merely laid down and rolled up again, very little wear from friction is incurred.

All doubt as to the effectiveness of pneumatic power applied in this way may now be considered as dispelled by the success of a compressed air engine at Govan colliery, near Glasgow, which has been working for more than six years without requiring any repairs or adjustment. The air-engine is situated half-a-mile from the steam-engine and compressing-pump, yet, as the pipe conveying the air is of large diameter, viz., 10 inches, the pressure of the air is diminished only 1lb. per square inch in passing through it. However, there is so much nicety and complication necessary in the compressing machinery, and in the apparatus for neutralising the great development of heat occasioned by the process of obtaining air at only 20lbs. pressure to the inch, that I think the principle must be abandoned, and we must give up, at any rate for a long time, the advantage of possessing such an extremely light as well as powerful locomotive power in our fields.

For making the steam-engine itself an agricultural locomotive, we have Mr. Boydell's "endless railway engine." I need not describe in detail this admirable working-out of an old idea. By bridging over hollows and forming inclined planes over obstacles; by stepping, as it were, instead of rolling, and laying down smooth even iron rails on which the wheels run; and still further, by bearing with flat platforms instead of curved wheel-tires upon soft ground, the shoes or rail pieces marvellously ease the progress of a ponderous machine. And thus the "traction-engine" can climb considerable gradients, as proved at the Salisbury agricultural meeting: and whether we adopt the particular form of engine there exhibited; or Mr. Burrell's appliance of the rails to common portable engines; or Messrs. Tuxford's compact and manageable engine on three wheels, in which both the main travelling wheels are driven, whether turning a curve or proceeding in a straight line; or Mr. Collinson Hall's enormously high-pressure locomotive, with its peculiarly-shaped boiler and steam-chamber maintaining the water levels always above the tubes,— it is now clear that the farmer's engine may be independent of his horses, that it can draw from farm to farm the heavy threshing machine it works, and pull home the harvest sheaves or lead out those loads of farm manure which now tax the power of our teams so many weeks in the year. From the many experiments made and published, it is certain that the "steam-horse" can drag implements in moderately level land at a very expeditious and cheap rate; which is not surprising when we consider that the engine brings the implements, the coal and water enough for the day's use into the field with it; that no tackle has to be laid out and fixed, or taken up and shifted, that the amount of manual labour required is very small, and the time lost in turning and removing comparatively trifling.

How long a traction engine will last in constant field use I am unable to say; but everybody knows how the rough journeys of common portable engines tend to damage and deteriorate them; and though the rails prevent much of the shock and strain which would be otherwise felt, continual travelling over a hard and rugged surface like arable land must have an injurious effect upon a ponderous boiler and machinery. The wear of the rails is also a very serious item. The objection that the great weight is calculated to injure a strong soil by undue consolidation, applies to the traction engine as well as to horses, but not with greater force. For an engine of 8 or 10 tons traversing a field weighs but little more than the number of horses requisite to pull the same implements; and their feet penetrate and injure the ground more deeply than the broad platform rails.

It appears that a momentary emergence of the tubes above the water level in the boiler is not dangerous; but for maintaining a nearly horizontal position upon long inclines, might not ordinary boilers be supported about the middle of their length, and raised or lowered at one end by means of an adjusting screw?

I am very hopeful of the extensive adoption of the traction engine upon very level land, for ploughing or scarifying whole ground; but fear it would be impracticable for working land already ploughed, so much of the motive-power being wasted in carrying itself over rough and yielding furrows or large clods.

It is to be regretted that the adaptation of the ploughs to the traction engine has hitherto been so unfortunate as to prevent the accomplishment of a high quality of work. Mr. Smith, of Woolston, has just patented an improvement in the yoking of the implements.

Before quitting the subject of locomotive engines for traction, I ought to mention Mr. Halkett's recently-proposed system of "guideways," or rails laid 50 feet apart over the entire surface of the land, for the conveyance of the engine and tilling machinery. The advantages promised on clay soils are prodigious, but I believe not the less reasonable and likely to be realised; and I would dwell longer upon the mechanical merits and economy of the plan, did I not believe that the first outlay, of £25 to £30 an acre, effectually debars its employment to the tenant farmer, while there are but few estates, I suppose, on which landowners are likely to apply

it, or on which a public company might obtain power to operate. And I prefer to notice schemes of steam culture for tilling our fields as at present laid out, as more immediately practicable and available than those requiring the complete remodelling of estates.

For ploughing, and scarifying, &c., in a hilly country, we must have recourse to the windlass and rope as the best means of transmitting power from the engine to the implement; and it is a question whether this or the traction engine principle is best even for level districts.

Of several plans which have come before the public for working implements by a stationary engine and windlass, only one now survives. Mr. Fowler, having tried one method which wasted too much time in shifting the anchorages, and another which, though with these self-shifting, required a great length of rope, has adopted the system of moving both engine and windlass along the headland. Mr. Smith, of Woolston, adheres to the stationary engine and windlass; for though it involves the use and wear of wire-rope laid all round the field instead of once up and down it, and loss of power also in passing the rope round four anchored pulleys instead of only one, it enables him to employ a very compact form of winding-machine or capstan, and relieves him of the difficulty of moving the heavy machinery along the headland. The anchors at both ends of the work are removed at intervals into holes dug for them by hand labour, and a man is necessary to guide the rope into proper coils on the drums; so that with the engine-man, and a man and boy with the implement, five men and a boy are engaged in working the machinery, besides the horse and hands fetching water. The working cost of deeply breaking-up the soil, at 5 acres a day, including the shifting of the tackle, is 5s. 2d.; and of trenching and subsoiling (3 acres a day) 8s. 8d. per acre; the wear and tear being taken at 1s. 6d. per acre more. The price of the tackle and implement adapted to a common portable seven-horse engine is £220; and the experience of several farmers seems to show that it is worth while to lay out this sum, and then expend the above amount per acre for autumn cleaning and other preparations, even though ploughing itself may be left for horse-labour.

Mr. Smith's method of turning the implement at the end of its course, by simply having it yoked to the ropes by a "turn-bow" or hook in front, is the simplest and readiest possible. I shall refer to his system of tillage by-and-bye; ordinary "ploughing" not being included in it.

But may not this hauling by wire-rope with a stationary engine be pushed too far? When a very great length of running rope is out, the friction of the slack portions of the rope on the ground (the tight parts resting on friction-rollers), that of the pulleys or snatch-blocks on their bearings, the bending of the rope round the pulleys, and other conditions, consume a very considerable amount of power, besides occasioning a large amount of wear; and our object should, therefore, be to place the engine as near its work as may be consistent with no undue loss of time in shifting anchorages and turning the implement at the ends. This was the principle acted upon in the earliest practical trials of steam-ploughing, a medium between the travelling and fixed motive-power being chosen, by arranging the engine with its winding-mechanism upon the headland, and shifting it so as to be always opposite the ploughing. If we have two engines with coiling drums, one at each end of the field, and two implements moving in opposite directions, the ploughs will be at the least possible average distance from the motive-power. However, the very great prime cost, the cumbersomeness and difficulty of moving so much heavy machinery from field to field, the time lost in adjusting the two implements at the end of their work, and other considerations, are unfavourable to the scheme, except when ploughing is undertaken on a scale of great magnitude, and the engines are constructed so as to be perfectly capable of steaming their own way from farm to farm.

A better plan (indeed, the first ever brought into actual operation) is to employ one engine and winding-gear on one headland, and an anchorage and pulley on the other, both being shifted along as the work proceeds, and a single frame of ploughs being hauled up to the engine or pulley alternately. This is the plan adopted by Mr. Fowler; and, for comparing the saving of power effected, suppose a plot to be ploughed is 200 yards square, with a stationary engine and windlass the average length of rope running at once would be 600 yards, and the average distance of the implement from the windlass 300 yards; with a shifting engine and windlass, the average length of rope out is 400 yards, and the average distance of the implement 200, that is, one-third less. There is a further economy of power in having a direct pull upon the plough with one rope, and round only one pulley with the other, instead of round two pulleys with both ropes, as in the stationary windlass method. There is, therefore no doubt that Mr. Fowler could haul Mr. Smith's implements with greater results than have yet been attained by the latter gentleman's rectangular method of working the rope; so that it is the simplicity and lightness of machinery and apparatus, rather than economy in working expense, which form the favourable points of the Woolston system. One advantage of Mr. Fowler's plan is also that an unlimited extent of land may be ploughed with the same length of rope, fewer removals of the engine and tackle by men and horses being therefore required. I need not describe his ingenious anchorage, which propels itself onward, with its cutting disc-wheels always in the soil, forming a perpetual hold-fast or purchase, or the well-known engine with coiling-drums underneath, which also slowly creeps forward along the headland. A portable engine, by its inherent weight, forms such a capital fulcrum or resistance against the strain of the hauling-rope, that it was well to use it as such; but until we have the combined engine and windlass able to transport itself up-hill and along ordinary farm roads, I must view it as too ponderous and unwieldy for common farm use. One material point should be considered, namely, that to be immediately useful and successful, and patronized by the farmers generally, a steam-plough ought to be adapted to our present portable threshing engines, now distributed by perhaps tens of thousands throughout the the kingdom. Mr. Williams, of Baydon, connects a windlass on wheels with a portable engine, by means of a strong framing; and though he has not been able, I believe, to work his ploughs without horses assisting, this portion of his plan is on precisely the principle I regard as most feasible and likely to meet with general favour. Mr. Fowler has adopted a similar method of enabling the farmer to avail himself of the engine he already possesses—the windlass-frame, mounted on large wheels, being so constructed as to embrace an ordinary engine like a pair of shafts, one end of the boiler being supported on this frame, and the other remaining upon its own travelling wheels. It does not take much time to unite or separate the engine and windlass; when joined, they propel themselves forward on the headland as one machine, and when separated, three horses can take either part from place to place.

At the trial at Stirling, Mr. Fowler's machinery, manufactured by Messrs. Ransomes and Sims, ploughed heavy land 5½ inches deep, at the rate of 6¾ acres a day, for a total estimated cost of about 8s. per acre, which by horse-labour would have been 15s. per acre. On milder soil, 7 inches deep, at the rate of 9½ acres a day, for about 6s. per acre, which by horses would have been 8s. per acre; and the trenching implement going 12½ inches deep, ploughed at the rate of 5 acres a day, at say 11s. per acre, work which would need 6 horses for accomplishing only one acre in a day. The saving in the cost of ploughing we may reckon 35 per cent. on the loamy land, 40 per cent. on the heavy land, and say 60 per cent. in trenching; and it is here obser-

vable that the economical advantage of steam over horse-power is in proportion to the difficulty of the operation, whether arising from the stubbornness of the ground, or the depth of the tillage. The superior quality of the work, and the great benefit of turning over the furrow-slices with a rapid motion, and with no damaging pressure either by the plough-soles or by horses' hoofs, were points equally well demonstrated on that as on many other occasions.

The adoption of a shifting engine and windlass, I view as one of the best steps taken for cheapening the operation of steam-ploughing, a step that economises power, saves time, curtails labour, diminishes wear and tear, and lessens the first cost of machinery and tackle. For working scarifiers and other implements taking a great breadth at once, perhaps it would be well to employ Mr. Smith's removable anchors, instead of the self-shifting one.

Mr. Fowler's latest advance has been to triumph over one of the defects hitherto found in the coiling of the ropes upon the drums; he has dispensed with the man for regulating the winding on, and escaped the wear caused by the grinding and sawing action of the coils of rope upon each other, by giving up winding altogether and leading the rope round grooves in the drums. He is thus enabled also to keep every portion of the rope sufficiently tight to be held off the ground by the friction-roller barrows, so that the wear is amazingly reduced. The total length of rope is also lessened by one-third, and is now less than half that required for a field of given size by the rectangular method. Only eight hundred yards of rope are required for ploughing four hundred yards length of furrow, and the price of the entire apparatus for a 7-horse engine is £280. The hands required are only two men and three boys, besides the water-carters. I should also add here, that scarifier tines have been adapted to the plough frame, so that either ploughing or grubbing can be effected by the same implement; and, of course, any traction implement whatever, as for instance, Mr. Smith's subsoilers or scarifiers may be worked by the same tackle.

There are many districts in which the fields are generally too precipitous for the easy passage of an ordinary engine from side to side, much less to admit of a locomotive traction engine climbing over all parts of the surface. In such cases we must fall back upon the stationary engine; and we may adopt the direct hauling from a fixed capstan, ropes laid out in a rectangular form, and anchorages self-shifting like Mr. Fowler's, or removed by hand in Mr. Smith's manner, or we may save the wear of wire rope, and secure a light apparatus, by employing the travelling windlass of the Messrs. Fisken. In this arrangement the wire rope is fixed, being fastened to self-shifting anchorages at the ends of the work, and the windlass, with implements attached, winds itself along the rope from end to end, motion being communicated from the engine in one corner of the field to the rigger, gear work, and coiling drums on the windlass, by an endless hemp cord mounted upon frames with friction rollers, while, in order that this cord may be very light, it is driven at a high velocity. There are many advantageous points in this invention—the complete control which one man has over the windlass and implements, so as to stop or return at pleasure without signalling of any kind, and the facility with which the tackle can be removed from place to place being among the number, and it is to be much regretted that we no longer find it in a practical form before the public.

The hemp rope (manufactured so as to be impervious to wet) is so convenient for transmitting power, and I believe not liable to the rapid wearing out that we might suppose, that I will now offer a suggestion for its application in steep districts, where a shifting engine may be inadmissible; and here I would observe, that this paper is intended to be suggestive of mechanical improvements rather than a narrative of the achievements and performances of particular inventions. I believe that ideas are wanted, and beg to submit for your consideration a number of proposals with the diffidence becoming one who propounds methods deduced from theoretical considerations, from observations of the schemes of others tried on a great scale, and from mere working model and garden experiments of his own.

Suppose a windlass mounted on wheels not to travel up and down the field, but simply to shift itself along the headland as required, and hauling an implement by wire ropes and an anchorage, as in Mr. Fowler's plan. Let there be cutting discs (like those in Mr. Fowler's anchorage), to prevent the windlass from slipping sideways, and let an endless hemp rope transmit motion to a large grooved rigger on the windlass from a similar one on the engine at one corner of the field. I think a windlass with drums on a horizontal axis would be most compact and simple, and in order to permit of ploughing at various angles to the direction of the headland, the travelling wheels of the windlass frame might be capable of being more or less locked, so that it could advance as it were in an angular or diagonal direction, while the axes of the winding drums still remained at right angles to the line of ploughing. Mr. Fowler's grooved barrels would, however, be still better.

In re-modelling and modernising this essay, which was written a year ago, I am gratified to find that one of my principal suggestions has now been superseded by Mr. Fowler's simple method of temporarily uniting portable windlasses with an ordinary engine. I will merely state briefly that my proposal was to connect such a shifting and independent windlass as that just described with a portable engine, by means of a beam or bar fastened to the windlass-frame at one end, and to the axle trees of the engine at the other, provision being made for slightly locking the front wheels of the engine when required for steering. This beam was to be in two parts, with a right and left hand screw for altering its length, so as to regulate the distance of the engine from the windlass, and maintain the proper tension of the driving belt or rope. And the engine might be either shod with the "endless rails," or, more clumsily, travel upon a couple of short planks, laid down before and taken up behind it by hand labour, as in Lord Willoughby d'Eresby's plan.

I will now ask whether we may not relieve the anchorage of most of the present strain, and so have it of the lightest and simplest form, employ much less heavy rope, avoid the delays and hazards of "signalling," and save time at the ends by making the whole operation more automatic than at present. Suppose we give up the to-and-fro work with a single implement, and use two implements, ploughing always one way, namely, up to the windlass, one implement going backward empty while the other is in work. That part of the rope passing round the anchored pulley having only the draught of an implement out of work, and one length of slack rope to haul, may be very light indeed, and the anchorage correspondingly light and portable. No time would be lost in directing the implement into a fresh course, as each implement is steered as it travels backward precisely into the position from which it has to start. Directly one implement arrives at the windlass the other is ready to commence its journey, and perhaps the implement might itself "reverse" the winding drums by coming in contact with a lever connected with the clutches for this purpose, so that the change of motion might be almost instantaneous, and the ploughing perpetual and continuous. When it is considered that we now lose an hour or an hour and a-half in a day in changing, &c., at the ends of the work, the advantage of this plan is obvious. It is most applicable to ploughing in "lands" or "stetches," the track of one implement always the breadth of one bout from that of the other (as will be presently adverted to); but for flat work, in which the furrows are all thrown one way, crossing of the ropes would occur. This, however, merely requires the slack rope to be lifted over the plough in work, and the plough

returning empty to cross over the tight rope. For accommodating the length of the small rope passing round the pulley, to the varying lengths of the furrow in different parts of a field, it must be shortened or let out from time to time by means of a few reserve coils carried upon the ploughs. It would be an improvement upon the present mode of hooking the draught ropes to the implement if a "clip" were made use of, which could be instantly released by the ploughman; or if the ropes wrapped round a small barrel, held from rotating by a catch, and allowed to revolve when the pull or draught may be required to be stopped, in consequence of a stone, root, or other obstacle suddenly arresting the progress of the plough.

I now come to the second point—the construction of the plough or ploughing machine. And in the outset I would observe that we require a ploughing *machine*, and not merely a means of yoking separate ploughs held by men as before. When there no longer remain any animals to drive, and we have a steady, uniform unflagging draught-power, why are we to retain the workman in a mechanical employment, and thus perpetuate our dependence upon his unskilfulness, carelessness, or fatigue? When once relieved from the co-operation of horses, having voluntary movements and wills of their own, ploughing becomes a strictly mechanical operation; the attention and directing judgment of the ploughman are no longer necessary to overrule the animal power, and accommodate the implement to its movements; and therefore I regard as incongruous and objectionable all projects for steam culture with ordinary horse-ploughs held by hand. They are also expensive in labour, requiring more workmen than a ploughing machine does for the same number of furrows; and they are awkward, owing to the difficulty of conducting a succession of ploughs close up to the headland, and turning or shifting them for the return course. Contrivances for meeting this difficulty I cannot but look upon as wasting ingenuity in a wrong direction.

Mr. Williams, Mr. Fowler, and other inventors, have practically demonstrated that several ploughshares and mould-boards united in a single frame may not only make very good work, but also be of considerably lighter draught than single and separate ploughs, taking an equal number of furrows. Not only is the draught less, but power is gained in another way, by combining a considerable number of ploughs together. A rope pulling three ploughs, at a speed of three miles per hour, is dragged twice as far in the same time as a rope hauling six ploughs at 1½ miles per hour; that is, the power wasted in dragging the rope itself is double in the former case what it is in the latter, for the same quantity of work turned over, to say nothing of the double amount of wear. There is also a saving of time. If a three-furrow plough traverse the field in three minutes, and waste one minute at the end, one quarter of the day is sacrificed out of work; whereas, if a six-furrow plough perform the journey in six minutes, the one minute at the end amounts to only one-seventh of the day. Let these considerations be borne in mind, while we proceed to notice various forms of ploughing machine used or proposed.

They are of two kinds—one for flat work, in which the furrows are all thrown one way; and the other for making "lands" or "stetches."

Turnwrest, one-way, or flat ploughing is adapted for light land, and may be practised also upon well-drained strong soils. The most successful steam-ploughs have hitherto been those constructed for this description of work, the advantage attending it being, that an implement, taking three or more furrows at once, can be worked without requiring to be turned round at the ends, and with anchorages gradually shifting along the headlands; whereas, in ridge-and furrow ploughing, such an implement must be moved across to the other side of the "land" or "ridge," and the anchorages shifted a considerable distance forward or backward at every bout; while laying out the slack rope in the next track so far from the plough is also a difficulty. The implement having a simple to-and-fro motion, and the furrows all thrown the same side, it would appear at first sight very easy to fix two or three or more of Lowcock's turnwrest ploughs (with shares pointing both ways and self-adjusting mould-boards) in a frame, after the manner of the common double-furrow plough. But the difficulty is, that the ploughs must change their position sideways at each end of the work, in order to "track" rightly in going opposite ways. Lord Willoughby d'Eresby has displayed great ingenuity in providing for this necessity, but the space required for allowing the ploughs to pass each other places one so far behind another, and time lost in adjusting them is so considerable, that the principle is objectionable. There seems no other course than to have duplicate sets of ploughs pointing in different directions, one carried in the air while the other is at work. Messrs. Fisken attach the ploughs to the ends of their windlass-framework, travelling upon two pairs of wheels, one set at each end, and both pointing towards the carriage. The set out of work precedes, while that in work follows the windlass-carriage, the ploughs in each set being just far enough apart to allow the furrow-slices to turn over without danger of choking. Each plough-body is affixed to a separate lever, answering to the common plough-beam, and by very simple mechanism is raised or depressed at pleasure. Thus, instead of the ploughs entering or emerging from the soil simultaneously, they do so in succession, so as to plough square up to the headlands. In the system of direct-hauling by wire-rope, in which it is indispensable to avoid unnecessary mechanism, in order to have the implement as light and simple as possible, we can hardly expect such niceties as this; and, instead of an arrangement of levers, chains, screws, and sockets for lifting and lowering the ploughs individually, I can imagine no better principle than that of balancing two sets of fixed ploughs upon a single pair of wheels, as adopted by Mr. Fowler. The frame, hung midway upon the wheels, with a set of ploughs at each end, is tilted so as to bring the hindmost set into work; and when arrived at the headland, the attendant has simply to pull down the other end and steer the implement in its next course when the rope begins to move it onward. The two sets of ploughs are immoveably fixed upon the framing, pointing toward each other; the wheels, one running in the bottom of the furrow, left open at the last course, the other on the unploughed land, regulate depth and width of work, like the wheels of a horse-plough; and, by means of screws working in vertical standards, the frame can be adjusted upon the axle tree, according to the depth of ploughing required. The steerage is accurately effected by slightly "locking" the wheels with a regulating screw, under the command of the ploughman, who rides upon the tail of the frame.

I attach great importance to the saving of time at the ends; and this is one reason for approving of the simple construction and action of Mr. Fowler's plough. One of the main advantages of this implement is the lightness of its draught. From numerous experiments with the dynanometer, it appears that the draught of common horse-ploughs, when out of work, is 30 to 35 per cent. of their draught when ploughing an ordinary furrow. Now, in Mr. Fowler's implement, this sliding of the weight of the ploughs on the furrow bottom, is entirely avoided, the ploughs at one end of the frame balancing those at the other, so that the entire weight is carried upon the large patent-axled travelling wheels. I have tested the draught of the 4 furrow plough running empty upon the surface of the land, and found it to be only 3 cwt.; the draught of 472 yards of wire rope dragging along the surface of a clover lea, was 3 cwt.; the total draught of implement and rope being no more than that of 4 common ploughs drawn empty on the same surface. Of course,

with the rope supported upon friction rollers, the actual draught is much less.

I would suggest as an improvement, that this plough should be constructed say with two beams of ⊥ iron shorter than the present wood beams, and with two diagonally placed beams at each end, made of tubular or angle iron, on which the plough skifes or the scarifying tines might be adjusted by clasps or bolts and screws, for different widths of furrow.

This implement which, by ready alterations can plough ordinary furrows, trench two furrows deep with an effect equal, in dry weather, to that of the spade, break up either whole or ploughed ground by cultivator tines, or pare with broadshares, seems to me just the convertible valuable implement we need in connection with steam-hauling machinery, as this versatility so materially reduces our first outlay.

I now pass on to a consideration of ploughing in lands, ridges, or stetches.

Steam-tillage ought to prove of the greatest assistance to heavy lands, and not only to light lands, which may claim the reaping machine as their gift from the mechanic, it being specially adapted to their upstanding crops; and from the restricted area of permanent subsoil-drainage yet in existence, as well as other circumstances, the great majority of farms on our strong wheat-soils are undoubtedly ploughed, and I fear must for many years be ploughed in ridge-and-furrow "lands."

It would be possible to form a land with Mr. Fowler's plough, first going two courses (that is, once up and down the field,) on one side of the ridge, and then, with considerable loss of time, turning the plough end for end, and going two courses to complete the other side; but, still better, the ploughs at one end of the frame might be left-hand, and the other right-hand ploughs, the implement then not being turned round. The slack or return ply of the rope following the plough would have to be laid out sometimes half a land's breadth aside from the track, and a guide wheel running along the last open furrow would be necessary to regulate the parallel distance of the next ridge. The anchorage, I think, would simply need to be shifted half a land's breadth at a time. But there is one objection. When we consider that one of the chief points of good ploughing is to form the sectional contour of the land in a proper curve, so that every furrow-slice shall be lower in regular gradation as we recede from the ridge (in order that the harrow edges of all may be equally prominent); and when we remember that a skilful ploughman secures this form by adjusting the width, depth, &c., of each furrow according to its distance from and relation to the ridge or water furrow, and according to the previous shape of the ground, we perceive that no implement ploughing all its furrows one unvarying depth and breadth can be well calculated for this description of work. Perhaps Mr. Fowler may improve his ploughing-machine for stetch work, by giving the workman power to alter the depth of either side of the frame without stopping for the purpose.

Mr. Williams suspends his single set of ploughs upon levers capable of working vertically in a carriage-frame, each plough being independently raised or lowered, but the machine has to be turned round at each end of the work at every course, and taken across to the other side of the land—a difficulty which I believe Mr. Williams has not yet overcome without the use of horses—and the alterations of depth, &c., necessary for different courses, must occasion considerable delay. But it is unnecessary for each plough to have a "swimming" motion independent of the rest. There appears to be no practical obstacle to the employment of a considerable number of ploughs rigidly fixed in a frame, but, on the contrary, the lightness of framing and adjustments in proportion to the breadth of ground operated upon (so important in lessening the load to be drawn) is in favour of such an arrangement. We might take half a "land" at a time, if the machine would not be too cumbrous, so that when the ploughs are once "set" (with regulating screws, &c.), to their proper depth and position, according to the form of the surface to be ploughed, no alteration whatever would be necessary. But a frame of six or seven ploughs following each other, would be too long and unwieldy, therefore, let us turn half the furrows one way and half the other, the ploughs being in two sets, placed abreast, instead of following one another. The six ploughs will thus occupy only the same length of frame as three; the machine, indeed, with wheels in front and behind, will be of much the same dimensions as a scarifier. Mr. Coleman exhibited at Chelmsford a ploughing machine of this description, in which the ploughs were arranged in a V form, like a flock of wild fowl. Suppose we attach the ploughs to the bars or beams of the framework by a fastening somewhat similar to that of Bentall's broadsharer, so that they can be adjusted to different depths and widths, according as the ground may be level or in ridge and furrow. By raising the fore-end of the frame upon its carriage wheels (with a wheel-and-screw or lever movement), the ploughs are run out of work of their own accord, and by depressing the front, they are pointed in. Let there be two implements, ploughing only up to the windlass—in accordance with the method of hauling described in a previous part of this paper. One is to "gather," or turn its furrows inwards, forming a ridge in the middle, the other is to "split," throwing its furrows outwards, leaving an open water furrow in the middle; that is, the first implement makes "ridges," or "feerings," of a certain distance apart, and the other "makes up" the intervals, forming complete lands or stetches. Carriage wheels follow in the last furrows to sustain the weight of the implements, and for them to travel upon as they run backwards out of work. The manner in which the two implements would be worked, with a minimum of time lost at the ends, and a saving of power in several respects, has been already sufficiently described. I need merely refer now to the advantages of making the ploughs in each frame turn half their work opposite ways, and to the possibility of lightening the draught by avoiding sledging and sliding action as much as possible.

From numerous dynamometer experiments, it appears that in a heavy soil, if the whole draught of a plough in work be taken as 100, then, with the mould-board removed, it will be 90, drawn along an empty furrow it will be no less than 35, leaving 55 to represent the power required for cutting the slice. Much of the 35 per cent. may be saved by supporting the implement upon three or else four carriage-wheels, and shortening the sole as far as it can be done without causing the share to make a ragged uneven furrow-bottom. The 10 per cent. due to the action of the mould-board may also be reduced; for though the weight and friction of the soil upon the upper surface of the mould will remain, the weight lifted (several stones) may be mainly sustained by the traveling wheels, instead of borne by the sledge formed of the sole and the heel of the mould-board. The 55 per cent. due to the operation of the share and coulter, must not be supposed to arise merely from the dividing of the soil by their cutting edges; the share has a considerable weight of earth resting upon it, not only occasioning great friction upon the upper surface of the share (which cannot be obviated), but greatly adding to the pressure and friction of the under side of the share upon the furrow bottom. By forming the ploughs in our machine so that no part shall touch the furrow bottom, except a small portion of the share edges and soles, and by bearing the entire weight upon wheels of considerable diameter and broad peripheries, (or, perhaps, applying the "endless rails" to prevent sinking,) a very large proportion of the friction, cohesion, etc., of the horse plough may be dispensed with. There is also another consideration. A common plough exerts a great side pressure against the upright land side of the furrow, owing partly to the re-

action of the furrow-slice in turning over sideways, but principally occasioned by the diagonal direction of the share's cut. If the cutting edge of the share make an angle of 45° with the direction of the plough's advance, there will be a pressure against the side of the furrow equal to that needed to overcome the resistance directly in front of the share. But when we fix two sets of ploughs in a frame, half having right hand, and half left hand shares, instead of any side thrusts being taken with a sliding action upon the face of the furrow, the side-pressures of all the ploughs neutralize each other. By proper attention to these points, I conceive that an economy of power would result.

I have not time to detail the simple steerage by slightly locking the axle of the front wheels, the adjusting of the hind wheels to make them act partially as "soles" to the ploughs, or the short coil of reserve rope and the clip by which it is held. I need merely add that all the arrangements might be very simple, and that the implements would travel with their wheels partly running on the unploughed ground, but chiefly along the smooth and clean furrow bottoms, and only for an instant cross over the ploughed land. Of course the draught of a large implement taking six furrows at once must be heavy, but the load is sustained by the windlass and not by the anchorage. Perhaps the chief objection is the difficulty of making furrows of equal depth on uneven land by an implement of such great width.

Having now concluded my review of steam-ploughing properly so-called, and offered various suggestions for its better accomplishment, I must briefly allude to

NEW PROCESSES, ROTARY FORKING AND DIGGING.

First. *Implements operating by Traction.*—Mr. Smith, of Woolston, is very successfully carrying out a novel system of tillage, by means of trenching, subsoiling, and grubbing implements, without using the common plough, except for turning over clover lea and sward land, and this, indeed, he thinks to be hardly necessary. He combines subsoiling tines with the double mould-board plough, and follows with the single subsoiler, so that the land is left ploughed up in "drills" or "ridges," the subsoil at the bottom of the open furrows and trenches broken up and exposed to the atmosphere, while the strips of ground covered by the upturned furrow slices are also stirred and disintegrated. On all soils that are not thin or light, this must be a remarkably effectual fallow process; the partial inversion and complete stirring exposing such a large proportion of the staple and subsoil to atmospheric action. The subsoiling tines are exceedingly efficient, somewhat resembling spades, or square fluked anchors, in shape, and so sloped as not only to enter and pulverize deeply the entire breadth of a furrow each, but also to raise a considerable portion of the subsoil for admixture with the upper staple. And the various cultivators used (manufactured by Messrs. Howard, of Bedford,) are remarkably simple, strong, and effective, and possess very admirable contrivances for steering, raising and lowering, and turning round. My paper being confined to mechanical methods of applying steam power to tillage, rather than referring to tillage itself, I say no more here, except that Mr. Smith's land and crops testify to the soundness and value of his husbandry upon very heavy and also upon some other qualities of land; and his experience, fortified by that of various agriculturists, shows that there is economy in expeditiously breaking up ground by these implements at a total expense of 6s. 6d. to 10s. per acre.

We have been long familiar with the revolving harrow, forker, or scarifier, as brought before the public by Mr. Gibson, of Newcastle-upon-Tyne, Mr. Samuelson, of Banbury, and other inventors. And I believe the decision of practical judges respecting them to be that, while they may be admirable in certain cases for stirring ground already tilled, they are not able properly to break up and invert unploughed land. However, I do not quite despair of this form of digger for effecting the first and principal operation of tillage. Mr. Smith, of Lois-Weedon, has contrived an implement of this kind which answers perfectly well for pulverising and lifting up the subsoil from the bottom of the trenches previously ploughed along his "intervals," casting the furrow-slices of staple underneath, and depositing the subsoil upon the top. The tines (of proper cycloidal curve), instead of being arranged upon separate discs, forming a set of independently-revolving rowels, are all fixed upon one barrel; as the machine advances, the earth is crumbled and raised bodily by the teeth, and while it hangs momentarily suspended in air before being cast off by fixed scrapers, a couple of small mould-boards gather the upper soil (previously turned by a plough) on each side into the bottom of the trench, the earth from the digger falling upon it.

Could not a simple implement of this character be made for ordinary husbandry, in which the whole surface has to be cultivated? Suppose a similar digging cylinder or wheel, to take only the width of a common furrow, preceded by a couple of skim-coulters or small ploughs, that would pare the stubble or sward, and cast it into the furrow left open at the previous course; then the earth raised by the digger might be diverted as it fell by a sloping mould-board, and laid upon the top of the thin slice deposited by the skim-coulters. In this way a perfect inversion and burying of the surface would be secured, while at the same time there would be a thorough comminution of the soil, and no pressure or sledging upon the furrow bottom. I think the draught of such an implement would be comparatively light, as the weight would all be supported upon the axis of the digging-wheel, and help to force the tines into the ground. The implement would also be very convertible; for, by taking off the mould-board we should have a rotary subsoiler instead of a trencher, the soil being mixed instead of inverted; and by adding other digging-barrels on each side, we might have a wide grubber or cultivator. For the purpose first mentioned—that of ploughing or trenching better than the plough—perhaps it would be equally efficient with the combined implement, proposed I believe by Mr. Fowler, in which a furrow-slice is ploughed the full depth, turned precisely upside-down, and then broken by the points of Norwegian-harrow rowells following upon it.

Hanson's potato forker is another form of rotating pulverizer; could not Mr. Fowler apply the revolving blades or tines to cut the furrow slices of his plough crosswise? Motion might be derived from one of the travelling wheels, and thus ploughing and pulverizing would be accomplished in a single act.

Leaving now the traction principle altogether, which, in the case both of ploughing and scarifying by steam must be now pronounced fully successful, let us inquire into the merits of

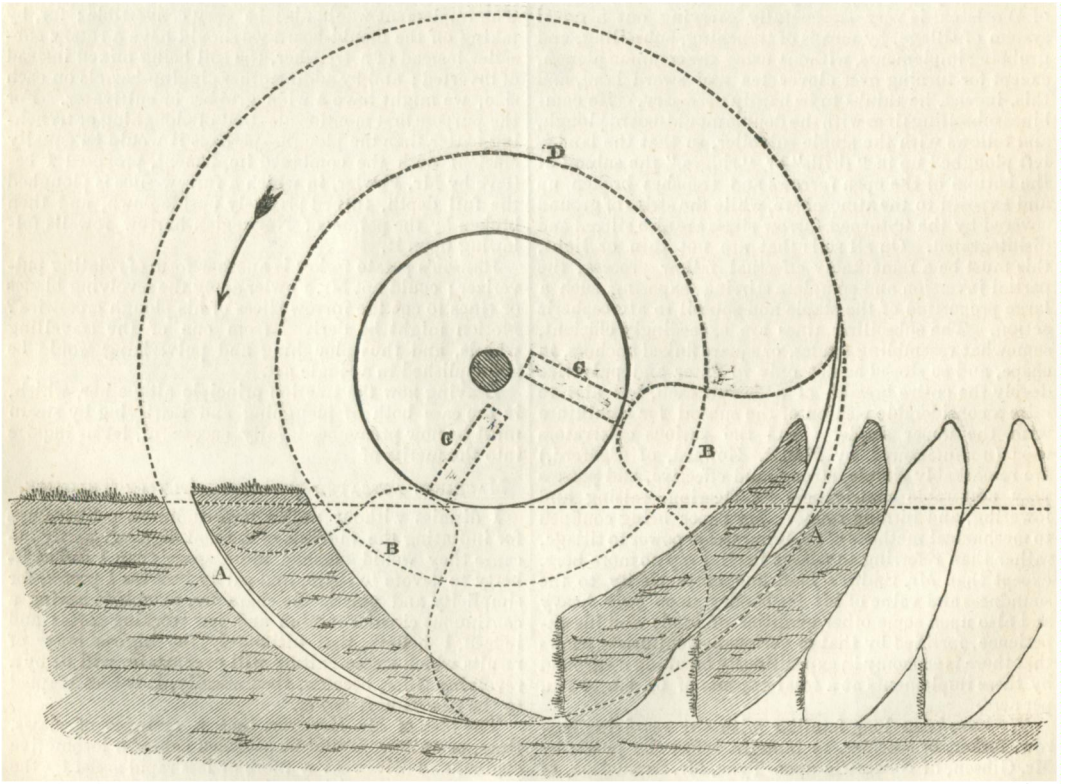
MACHINES ACTUATED INDEPENDENTLY OF TRACTION.

I dismiss without notice multitudinous contrivances for imitating the motions of manual digging, partly because they would demand more space than I feel at liberty to devote to them, and partly because I prefer, for simplicity and practicable character, machines having a continuous circular motion and few working parts; and indeed, I believe, that ultimately the highest order of results which steam-culture will ever attain, will be by a revolving tiller, because, theoretically, it is best adapted to the new motive-power.

The idea of Mr. Hoskyns, that a cylinder of claws, tines, or cutters, should be attached behind a locomotive engine, and driven at a more or less rapid speed by the motive-power, notwithstanding the success of steam-traction implements, never promised better than it does now. I do not know what has become of Mr. John Bethell's revolving forker, but, at any rate, Mr. Romaine's machine, in the hands of Mr. Alfred Crosskill, has, at

last, achieved considerable success, the velocity of the digger, however, being greatly moderated from that originally proposed. A rapidly revolving scratching tool may serve for superficial slicing and mincing as a substitute for paring; but in order to invert the soil completely, and perform the best kind of work required by the farmer in deep culture (for which digging machines seem most suited), I am of opinion that the soil must be cut or broken into pieces of sufficient bulk to be turned bodily upside down, and these must not be left to fall at hazard in any posture, but laid in their proper position by the machine, in order to make perfect work. This operation necessitates a slow rather than a quick rotation of the cutters; accordingly, Mr. Usher's rotary steam-plough, in which a series of curved plough bodies are attached about a horizontal axis driven by gear work, behind a locomotive engine, was a near approach to what we required, and had the tilling machinery been combined with a modification of the endless railway engine, or the difficulty of locomotion been otherwise better overcome, this invention would probably have given us a cheap, though not very perfect, order of tillage. But Mr. Romaine's cultivator is a decided success. A digging-cylinder, 6 feet wide, is attached behind a 12-horse engine, mounted on a pair of very large broad felloed wheels, with two steerage-wheels on castors in front. The machine is perfectly independent of horses for travelling from place to place over moderately level roads or arable fields, though its weight is 10 tons, and it will turn short round, or in an area of its own length. Parallel connecting-rods, like those coupling the wheels of a railway locomotive, are used for driving the digger with a speed of 40 to 50 revolutions per minute, allowing it to be readily raised or lowered while in motion. The cutters, fastened by bolts and screws upon the plate-iron cylinder, resemble scarifier paring-shares in form, and, as the engine slowly advances, slice and dig up the soil from either 3 or 4 inches to 10 inches deep, as required. Having seen the work done, I can bear witness that tenacious soil is thoroughly broken up and subdivided, the surface-stubble, &c., buried sufficiently well, and the subsoil largely upturned and intermingled with the top staple—in fact, the work has much the appearance of that of the digging-fork. The successive operations of ploughing, dragging, and harrowing strong land are equalled by a single course of this machine, and at a far cheaper rate, the amount of work done being from 4 to 7 acres a-day, according to the description of soil and depth of work, at an expense of 5s. or 6s., up to 9s. or 10s. per acre. The price, I believe, is about £800. It is a matter for experience to determine how far the weight may prove injuriously consolidating on stiff clays, and whether the farmer can keep in order so many wheels, running bearings, and working-parts. The cultivating cylinder, however, promises to become all that the farmer requires; only, for working on ground already ploughed or cultivated, on hilly fields, and on wet clay soils, I hope means will be found to actuate it by ropes from a shifting or staticnary engine.

In searching out and studying all the proposals I can meet with for digging or deeply trenching, I have concluded that the simplest, easiest, and most practicable idea, is that which is shewn in the annexed woodcut. A cutting-blade attached by an arm or stem to a horizontal axis, and curved concentrically, or nearly so, with the circle it describes, which entering the soil



A A. Position of the Digging Blades on entering and on rising out of the soil, cutting a spit say 8 inches thick and 9 inches wide, with the trench 15 inches deep.

B B. The stems or arms supporting the blades. These are sharp at their edges, so as to act as coulters for severing the side of the spit from the whole ground. The blades are set diagonally across the plane of the circle they describe, so as not to trick after each other; and are turned round in sockets, C C, when required to point the other way, for the return course.

D. Size of the wheel by which the digger is driven.

downwards, shall cut a curved spit of earth from the face of the semicircular trench formed by its action, and emerging upwards on the other side of the trench, leave the spit in an inverted position.

A number of these cutters are to be affixed by radial arms to the shaft, but in order that they may not impede the delivery of the pieces of soil from each other, I propose that they should be placed at an angle with the plane of the circle they describe, and let the machine advance at right angles to the direction of their revolution, the axis being longitudinal instead of transverse, just as in Hanson's potatoe digger, and Huckvale's turnip thinner. The digging-disc (supported and actuated in a way to be presently noticed,) proceeds sideways, as it were, along the trench, slicing off spits from the face or edge as a workman does with a spade, and carrying and leaving them on the opposite side inverted and turned end for end. The arm or bracket to which each cutting blade is attached acts as a coulter to divide the portion to be cut. Suppose the blades to be of 9 inches breadth, then one blade must enter the ground for every 9 inches travelled by the machine; and with six cutters following one another (somewhat after the manner of the knives in Gardner's turnip slicer) the revolutions per minute will be only 29, for a progression of 1½ miles per hour. The "bite" or thickness of the spit may be, say 7 inches, when the depth is a foot; thus, for a single digging disc, the extent of land dug would be at the rate of 1½ acres per day, but, of course, I propose to have several diggers on the same shaft. Working at less depth, the speed might be increased. For going 12 or even 15 inches deep, the disc need not be of greater diameter than say three, or at most four feet. And it is to be noted, that though of small diameter, as the digger works always in the trench, a spur-wheel of considerable size may be hung on the same shaft to drive it. I propose that the machine should traverse up and down the field, without turning at the ends, the digging disc always remaining in the trench and revolving the same way. The only change necessary is to point the cutting blades at a different angle when the machine is to travel the reverse way; and this is done by setting each arm or stem in a socket, and connecting the six arms so that they are turned round simultaneously. The blades are double edged, in order that they may be turned round so as to bring the arms into operation as coulters, whichever way the machine may be moving. But the form of cutter proposed is also adapted for revolving upon a transverse shaft or cylinder like Romaine's.

Motion may be communicated to the digging-wheel in several ways. It may be affixed to a locomotive engine. But I should prefer to drive it by an endless rope, supported upon friction-rollers, in connexion with a stationary engine, or an engine shifted along one end of the field,—a modification, in fact, of Mr. Atkins' and Messrs. Fisken's method. For a single digging-disc, perhaps there would not be too great a resistance to be driven by wheelwork from the travelling-wheels of the carriage-frame, on the principle of Hanson's potato-digger: the wheel having teeth or cogs upon its felloe to give it a firm hold of the ground, might travel along the bottom of the trench, and so partially operate also as a sub-pulverizer, breaking up the hard bottom, and, as the digging-disc is adapted to a pace of 2 miles per hour, horses might work it if required. I would suggest, however, that in case the bite and resistance thus obtained were found insufficient for very deep work, a couple of wire-ropes wound upon the drums of the machine, and fastened down at both ends of the field by shifting anchors, would cause the drums and connected gear-work to revolve by the simple advance of the machine; though this travelling windlass would involve considerable weight and complexity.

My description of this rotary digger is very general and devoid of details, the rather rude drawings accompanying this paper merely giving some idea of the circular cutting and inverting of a movement I advocate, and, in fact, it is not the particular form, but the distinctive principle of action involved, that I wish to bring before you.

In conclusion, let me hope that at least some of my suggestions with respect to working traction implements by steam-power, and the construction of new tillage machines, will prove useful to some gentlemen who may be practically grappling with the mechanical difficulties in the field, and that the principle I have introduced to your notice for deep-digging and perfectly inverting the soil, with the least possible waste of power in raising the cut pieces, will meet with your consideration and approval.

DISCUSSION.

The following letter has been received by the Secretary:—

SIR,—In the *Journal* of this Society for February, 1856,* are a few remarks, I then made, on the subject of ploughing, or land cultivation by steam-power. These impressions were arrived at, and forced upon my mind by the importance of the subject, and by frequently witnessing the various methods (ingenious and persevering) by which the desideratum was sought to be accomplished. I would now frankly have renounced my ideas, and cordially have congratulated any inventor who had, by this time, made the progress then hoped for, and which their great efforts have really deserved; but feeling, as I do, that so little improvement has been made in the art by any of the methods during these two years, I am more convinced we are not yet in the right path to the possession of an implement such as would generally supersede the good horse plough, and which the enterprising agriculturist would hail with pleasure and readily adopt. Sincerely feeling, as I do, how very ungenerous and hard it may seem to these energetic pioneers to dwell on their unrewarded efforts, I would gladly adopt any course of remarks or argument, which would avoid allusion to a failure, or touch a disappointed hope, and would, therefore, briefly state that from all I have yet seen or heard of improvements and trials of the now existing means, I am forced back to the conclusion I had arrived at in February, 1856, that the thorough and practical steam cultivator is to be wrought out of such a construction of machine as I then sketched. It may, with seeming justice be asked, why I disapprove of all existing plans, and still do not produce my own idea in a competitive form. My answer is, that during these years I have, through impaired health, been compelled to relinquish, in a great measure, the practical management of our somewhat large manufacturing business, and those left to do so find their heads and hands full enough in grappling with the large and small details of works requiring increasing attention.

The machine I had sketched in 1856, I still think well worth the consideration of one or more possessing the ability and bold determination of some of the gentlemen I have alluded to; and should success be theirs, I will be satisfied with that which is only due to me, for having pointed to the outline of an implement for so desirable an object. I would very shortly repeat, that the machine I proposed was in the form of a portable engine, not much exceeding in weight and size that now used to work a combined threshing machine; the addition and difference would consist in a frame containing a number of digging spades, and the application of the engine's power to the up and downward motion of the spades, and turning over the pieces of soil they lifted much in the same way as a man does with a spade. I think I may fearlessly assert that no plough has ever equalled the spade in beneficial results to the soil and its productions; the expense and insurmountable difficulty of having the work

* See Vol. IV., page 172.

done within the necessary time by men being the objections; and, if so, then the implement we really require is some twenty or more spades worked by the uncomplaining giant steam, so obedient and untiring. The arrangement of the spades, and their required motion are not insurmountable difficulties in the science of mechanics, while the engine's weight, instead of being a drawback as at present, would be the intermediate power by which I would force the spades into the ground, and these spades would act as so many levers, by which the machine would be moved step by step. No space, whether the field was large or small, would be left untilled any more than in the case of the best ploughing, and the digging would be deep or shallow at the option of the attendant, or as the frame had been set for him. No power would be misspent; the whole apparatus would be as free from derangement as the portable engine and threshing machine now are, and quite as portable; for when the work was done, the spade frame would either be lifted clear of the ground, or disengaged, and the travelling wheels left free for locomotion. In common with so many, I long to see an efficient machine for such a great work; and if my ideas should now fall into genial soil my object is served.—I am, &c.,

RICHARD GARRETT.

Leiston Works, Saxmundham.

The CHAIRMAN said this was a most important subject, for he thought that we were in a state of transition as regarded the cultivation of the soil. He had no doubt that, in process of time, the ingenuity of this and other countries combined would bring steam-ploughing, as well as reaping by machinery, into general use. More attention was required to the machine itself than to the engine which was to work it; the latter might be considered as having been brought almost to a state of perfection. He had an opportunity, at the Paris Exhibition, of witnessing the operations of from twelve to fifteen different steam reaping-machines, and he had reported upon them to the Government of this country. Throughout those experiments, it struck him very forcibly that more was wanted from the farmer than from the engineer, inasmuch as a great deal depended upon the land being brought into a state fit for the application of machinery. Until attention was paid by the farmer to this point, it was in vain for engineers and inventors to bring forward machinery for the cultivation of the soil. It appeared to him that, in good cultivation, the first step was to carry off the surplus water by a complete system of drainage, to increase the depth of the staple, and to bring to the surface portions of the subsoil. He believed, if those necessary preliminaries were carried out, they might apply machinery to the cultivation of the soil with good effect, and at a cost which would be within the means, not only of the gentleman-agriculturist, but also of the tenant-farmer. He saw many practical men present, and would be happy to hear their observations on this highly-interesting subject.

Mr. J. J. MECHI was of opinion that steam-cultivation would, ere long, become the custom of the country. He would mention that two years ago Mr. John Fowler ploughed a quantity of land for him, and he could assure them of the marked superiority of the crops on the land so treated, as compared with that subjected to the ordinary horse-ploughing. There was a difference in the crop of wheat, of at least a quarter per acre in favour of ploughing by steam. The superiority was apparent from the first appearance of the crop, and was maintained up to the time of harvest. The depth to which the land was ploughed was considerable, and, in addition to this, subsoil ploughing was also employed. The work was allowed, even by the labourers, to have been done with much greater regularity than could be effected by horse-ploughing, and fresh soil was brought to the surface which had never before been disturbed by any implement. It was true the work was done some little time before the crop was sown, and no doubt the action of the air upon the raw subsoil was very beneficial. He thought they would all agree as to the superiority of steam over horse-power, wherever it could be brought to bear. An acre of ploughing per day was considered fair horse work, and that would be done by 2 o'clock in the afternoon, at which time the horses returned to the stables, and remained there eating and sleeping till 6 o'clock the next morning. In the summer months especially, an immense amount of time was thus wasted, and the horses must be kept and fed whether they worked or not, so that all experience tended to show that horse-power in the cultivation of land was but a make-shift, and must, he thought, ultimately succumb to mechanical contrivances. His impression, some years ago, was that Romaine's engine would be very effective, and he had spent some £700 in experiments with that machine. Since then he believed £10,000 had been expended in experiments, and with very important results. He had no doubt larger sums yet must be spent before they arrived at perfection, and every year would witness large improvements in the application of steam machinery to the purposes of agriculture, as was the case with regard to manufactures. He hoped the farmers of the country would be sufficiently alive to the importance of adopting these appliances when they were offered to them. It was certainly not the duty of the tenant farmers to lay out their money in making these experiments, but at the same time they ought to be willing to pay a fair remuneration to those who afforded them the means of carrying on superior cultivation at a cheaper rate. By the facilities of inter-communication afforded by railways, many local prejudices had been abolished, and districts which formerly prided themselves that they were in the van in agricultural matters, discovered how much they were behind-hand. After all, depth of cultivation after good draining was the true manure. Let the subsoil be brought into contact with the air, and they would find a treasure which had never before been developed. He had every year increased the depth o cultivation on his land, and had always been rewarded for it. Recently he had a field dug all over with the steel digging fork, and he had found it more economical in its results than ploughing with horses. There were five horses ploughing in one field, and in another field four men fork-digging, and he found the latter cheaper at £2 per acre, the men earning 2s. 6d. per day, than the work of five horses and two men in ordinary ploughing. The more he saw of horse power the more convinced he was that it was the worst and most costly power that could be employed, but at present the use of it was unavoidable.

Mr. J. ALLAN RANSOME said, that the very able paper they had heard was certainly a most accurate record of all that had been done in the application of steam machinery to agricultural purposes up to the present time, and many of the suggestions put forth, he felt, were extremely valuable. On the two previous occasions on which he had attended discussions on this subject, practical progress in this direction had been shown to be extremely limited. With the exception of a little work carried on in one season on Mr. Smith's farm, nothing had been practically done when the subject was first discussed in that room—at least so as to induce others to follow in the same steps. Since that time great improvements had taken place in the three leading plans referred to in this paper, namely, first the locomotive traction engine drawing an implement after it; secondly, the steam-engine employed to give motion to rotary machinery; and thirdly, the employment of traction ropes with a fixed engine. He had already expressed an opinion in favour of traction by means of stationary engines. His attention had been principally directed to the latter system, from the belief he entertained that the best practical results would be derived from it. Looking at the results of Fowler's method of steam-ploughing, it

had up to the present time been found very effective. This was shown by the fact of a 12-horse engine working five ploughs during the week, at the rate of an acre per hour. To accomplish the same work with horse-power, would take 16 horses. The number of men in the one case was five, and in the other eight; in the one case they must be all skilled ploughmen, whilst in the other they required only one person competent to drive an engine, another able to guide the ploughs, and the remainder could be done by boys. It was further to be remarked that, during the necessary period of rest and feeding both for men and horses, the steam-engine might be employed in other operations on the farm. He would now speak of another class of implements. The plough was universally admitted to be inferior to the spade. Why was that so? There must be some detrimental effects produced in ploughing which must be set against the good done to the land. In the first place, there was the treading of the horses' feet, and, in the next place, the hardening of the soil by the action of the broad bottom of the plough. He regarded the implement which had a tendency to break up and comminute the soil as the nearest approach to perfection; and where the steam plough had been introduced with the avoidance of friction, and where the soil was broken up by an implement following in the wake of the plough, he believed it was quite equal to the process of digging, and he thought this might be effected by the traction rope and fixed engine. At the same time, he thought that a lighter description of engine might be adopted which could be used as a rotary travelling engine. But whilst there was work sufficient for each manufacturer in his individual line, he thought ploughing by traction had been almost brought to perfection; but with regard to a thoroughly practical digging machine, he feared that the probability of success was rather remote. The necessary complication of such a machine would stand in the way of its success. He lamented as much as any one that the state of his friend Mr. Garrett's health had delayed his further progress in that direction, but his friends might console themselves that he had thus been released from a matter which would certainly have occasioned him a great deal of anxiety; and in the event of Mr. Garrett's restoration to health, he (Mr. Ransome) would advise him not to expend his energies upon the invention of a digging implement to be worked by steam.

Mr. J. J. MECHI mentioned, as a proof that Fowler's method of ploughing was coming largely into use, that a contract was taken for ploughing 200 acres by this plan on a farm in Essex. This showed that it was in large practical operation, and he had no doubt that it would answer.

Mr. NEWTON, although not a practical agriculturist, would venture to differ from some of the views expressed by Mr. Ransome. He did not think ploughing—taking the plough in the form in which they were acquainted with it—could be beneficially carried out to any great extent in this country by means of traction power. Whether the implement was capable of modification so as to obviate the hard under surface occasioned by the sole of the plough, he could not say. Every agriculturist would admit that ploughing was not so beneficial an operation in the preparation of the land as hand labour with the spade, but this was so expensive as to be out of the question. He thought the application of traction by ropes to the plough involved great waste of power, and the friction of the rope on the ground occasioned an amount of wear and tear which formed a serious item of expense. Nor was that the only objection to ploughing by steam under the method adopted by Mr. Fowler. There must be great waste of time, especially in small fields of six or seven acres, in arranging the anchors and windlass, and also in the lateral shifting on the headland. It was stated in the paper in some instances to occupy 25 per cent. of time throughout the whole of the day. That formed a serious item. If they had large fields, such as were seen on the Continent, the case might be different, and in fields of 100 or 150 acres, Mr. Fowler's plan could probably be carried out with advantage. They must, however, take the case as it stood in this country. They could not remodel estates.

Mr. MECHI said this *must* be done.

Mr. NEWTON very much questioned whether the landlords as a body would allow their tenants to grub up the hedges, and cut down the trees, to form open lands on their farms. Reference had been made to Romaine's cultivator. That machine could be taken to any field where the gateway was wide enough to admit it, and every foot of the land could be cultivated by it, without any further operation being required, besides which it was capable of being adapted to all the purposes for which the portable steam engine was employed upon a farm. The cost of that machine was stated in the paper to be £700. It ought, however, to be borne in mind, that an implement of that kind dispensed with a considerable amount of horse power. He believed it was not generally known that the horse power for agricultural purposes in this country consumed from one-fifth to one-sixth of the whole produce of the land.

Mr. MECHI said, on small and moderately cultivated farms it would amount to one-fourth. On well cultivated lands it would be about one-fifth.

Mr. NEWTON added that such an item in the expenditure on a farm was very serious. He repeated his belief that the system introduced by Romaine would ultimately be found to be most successful in the cultivation of the land, from the fact that all the necessary operations were effected at once.

Mr. MECHI wished to explain that in stating the consumption of the horses on a farm to be, in some cases, one-fourth of the produce, he did not mean one-fourth in value, as of course horses were not fed upon wheat, but the produce arising from one-fourth of the extent of the farm.

Mr. JOHN FOWLER had listened with great interest to the able paper of Mr. Clarke, which he regarded as a most excellent *résumé* of what had been effected in steam culture up to the present period, and an extremely fair criticism upon the merits of each invention. With reference to the remarks of Mr. Newton, although he agreed with him in the belief that rotary cultivation in some shape or other would be ultimately brought to bear, yet they could hardly assume that it would do all that was required. It was possible that rotary cultivation might effect the overturning of the soil, and he believed there was no very great difficulty in bringing it to bear for that purpose on level and firm soils, but upon very uneven surfaces the power expended in taking the machine over them must be very great. Of course there were many improvements in detail which might be made in such a machine, and he should be glad to see the gentlemen agriculturists of England—for it was not the place of the tenant farmers to do it—appropriating a small portion of the income which they derived from the land to experiments in rotary cultivation. With regard to himself, he ventured to say that the system of ploughing he had introduced was a step in the right direction. He thought there could be no question that it was a really practical plan, inasmuch as it performed the ploughing at half the cost of horse-power, and the work was better done. He was happy to have the testimony of Mr. Mechi in its favour, though it was by no means the first he had had. Seven acres of sandy soil, in the neighbourhood of Ipswich, had been ploughed by steam, and the result was, even on land which had no rich subsoil to be turned up, that a yield of a quarter per acre more in the crop was obtained. The people in the neighbourhood suggested that the difference arose from the depth of the tillage having prevented the drought from attacking the wheat. He admitted the superiority of hand-spade cul-

tivation over even steam ploughing, but it was too expensive in practice, and he was prepared to say that, on heavy clay land, steam-cultivation, equal to spade-labour, could be done for 12s. an acre. With regard to the wear and tear of the rope under his system a misapprehension existed. Upon clay land, he would guarantee the wear of the rope at sixpence per acre; he believed it would not exceed 3d. per acre; but if the work was done upon gravelly soil, abounding with sharp flint stones, greater care was necessary with regard to the rope, although in such cases he believed the expense would not be greater; but if farmers used the rope in the careless manner they frequently did their steam-engines, of course they must be content to bear the expense of their negligence. Judging of what he had seen of rotary cultivators, he believed that they would occupy a prominent position in a few years, and no pains should be spared to bring this about. There was one point which bore materially upon steam cultivation. The moment they were prepared to do all the cultivation on a farm by means of machinery more advantageously than by horse-power, horses themselves would only be required for the carting, and would have to stand idle a large portion of the week. This showed the importance of bringing about a perfect system of steam traction. Mr. Boydell had gone far to develop that. He (Mr. Fowler) believed that a smaller class of that description of engine—say of four-horse power—could be used for the work of a farm more economically than horses. He thought it ought to be fairly tried. Who was to try all those experiments? Were the inventors to bear the whole brunt of that which was in fact a national benefit? The landlords hitherto had done little. The Royal Agricultural Society had given no help. He could only state that the trial of his system at Salisbury was appointed to take place on a steep hill, resembling the roof a house, and the decision arrived at was that the steam plough would not answer. Notwithstanding all this, he was prepared to prove that he could plough at half the cost of horse power. It was plain they would get no assistance from the public or from the landed proprietors, who would, after all, derive the greatest benefits in the improved rental of their estates. As far as steam ploughing was concerned, he considered his task was done; but it was for such men as Messrs. Romaine and Boydell to carry their experiments further in another direction, and he was strongly of opinion that the public at large ought to help them in their work.

Mr. SMITH (of Woolston) avowed his determination not to receive any assistance from any society or any individual. He would state his reasons for not using the combined plough for the inversion of the soil. In January, 1856,* he stated before this Society what he had done in the way of steam tillage up to that period, and he would now state what he had done further since that period. He would not speak of his own plough, but would refer to the machinery employed for laying out the land and the mode in which he effected it, as upon that he considered the success of his system of tillage mainly depended. In the two experiments referred to by Mr. Clarke in his paper, one at Chelmsford and the other at Woolston, he (Mr. Smith) had not space enough to show properly how he set out his work. Mr. Smith proceeded to explain the details of his plan, particularly describing the mode of setting out his machinery and tackle. (This, however, would be unintelligible without the plans and sketches to which he referred.) Mr. Smith went on to remark, with reference to steam culture, that all farmers would admit that the first month after harvest was worth all the other months of the year put together. There were, in fact, only two months which were really valuable to the farmer for ploughing. Those were September and October. The engine which he recommended was the common 8-horse engine, but he had found a 7-horse engine sufficient for all his work, upon a farm of about 200 acres, 110 of which were arable, and the engine could do all the threshing, grinding, cutting, &c. The tackle to be attached to it, he contended, was paid for in the first season it was used. He had found in his own experience and that of his brother farmers, that a quarter per acre more in the yield of the crops resulted from his system. Mr. Smith next proceeded to contrast the system of anchorage and rope traction adopted by Mr. Fowler with his own plan, and pointed out the important reduction he had made in the number of horses he had employed previously to the introduction of his system of steam-cultivation. In the first year he steam-ploughed a field twice over, and the yield was 41 bushels of peas per acre; the succeeding crop was barley, and the yield of that was 7 quarters 1 bushel per acre, from land which formerly only gave a yield of 5 quarters per acre. Upon an average he employed his steam machinery in culture 39 days in the year, consuming 14½ tons of coals, at a cost of £14 10s. The only additional cost was in increased labour, for during that period he had allowed his men sixpence a day extra. Mr. Smith then read letters from Mr. Randell, of Chadbury, near Evesham, Mr. Bright of Teddesley, Mr. J. Whiting of Stoke Goldington, and Mr. George Taylor of Mentmore, speaking of the successful working of Mr. Smith's system of steam-cultivation, on land in their occupation, or under their management.

The CHAIRMAN regretted that the time had arrived for closing this discussion, more especially as he saw present several other inventors—amongst them Mr. Halkett—from whom he had hoped to hear some observations on this highly important subject. They would, however, all agree that Mr. Clarke was entitled to their best thanks for his able paper.

A vote of thanks was then passed to Mr. Clarke.

On the table was exhibited a clock case, elaborately carved in box wood, designed and executed by Mr. W. Perry, of North Audley-street. The design represented an oak tree with various birds on the branches, and with wild flowers and a stream of water at its base.

The Secretary announced, that on Wednesday evening next, the 17th inst., a paper by Professor Crace Calvert, "On Recent Scientific Discoveries as applied to Arts and Manufactures," would be read.

EXAMINATIONS.

Mr. J. C. Macready, one of the Honorary Local Secretaries of the Society of Arts, recently gave a reading from the English Poets at the Town-hall, Poole. The *Poole and South-Western Herald* states that "the special object which this gentleman had in view was the raising of funds in order to enable the Poole Institutes to form classes in various branches of education (in conjunction with other Institutions in this part of the country), to be conducted in accordance with the rules, and in connexion with the Society of Arts; and the members to be admissible to the Society's Examination for prizes and honorary certificates."

HANTS AND WILTS ADULT EDUCATION SOCIETY.

This Society, which is in Union with the Society of Arts, was established in 1853, and its objects, as stated generally in the prospectus, are—1st, the establishment and assistance of Literary and Scientific Institutions, libraries, whether stationary or itinerating, reading-rooms, and evening schools; and 2ndly, the en-

* See *Journal* Vol. IV., p. 175.

couragement of a spirit of improvement either by the delivery of lectures, and the formation of classes; or by examinations, certificates, and prizes. Its operations include the counties of Hants and Wilts, with such other places as, by reason of contiguity, or for convenience sake, are accepted by the committee.

The honorary secretaries who have been especially instrumental in carrying out its objects are, the Hon. and Rev. Samuel Best, Mr. Wyndham S. Portal, and the Rev. Thomas Bacon. It was originally instituted merely as a Lecturers' Association for mutual assistance, and it afterwards undertook, by the aid of lecturers, to promote the establishment of libraries, reading-rooms, and evening schools, all its machinery having been brought to bear on the improvement of the adult population.

The members are 1st, annual subscribers of £1, or donors of £10; and 2ndly, lecturers who, their services having been accepted by the committee, have given or undertaken to give at least three lectures gratuitously, in the current year, to Institutions in Union with that Society, and without any compensation by mutual assistance. Members are entitled to admission to all lectures, and to the free use of diagrams, models, apparatus, &c., in any of the Institutions, or in their own houses. Subscribers of 10s. are entitled to admission to all lectures.

The committee have appointed, in different districts, honorary local secretaries, who materially assist in carrying out the objects of the Society.

The terms upon which Institutions and schools are admitted into union with the Hants and Wilts Society are as follows:—

Institutions in Union with the Society of Arts, if within the districts embraced in the operations of the Hants and Wilts Society, are entitled to free admission into union. Schools are admissible on payment of 5s. per annum, and any peculiar Institutions at the discretion of the committee. Ordinary Institutions and reading-rooms are taken into union on forwarding to the secretary an application to that effect from any member of the Institution who is also a member of the society.

There are at present about 90 Institutions and schools in Union with the Hants and Wilts Society.

It publishes annually a list of lectures offered gratuitously to the Institutions in its Union, and otherwise promotes this branch of adult instruction. In the autumn of 1855, at a meeting of the Society, held at Basingstoke, it was resolved to offer premiums for the encouragement of evening adult schools. The gratuities are given on the following conditions:—

"1. The gratuity offered by the Society must be doubled from local sources, independent of the class fees.

"2. No pupil under the age of 15 years shall be counted, with a view to the gratuity, unless employed in industrial occupations during the day.

"3. The amount of the gratuity will depend on the number of scholars who have attended not less than 80 hours, and on the number of hours the school has been open.

"4. Reading, writing, and arithmetic shall be deemed essential subjects of instruction. The knowledge of Scripture, geography, English history, and of any branch of science will be favourably considered and reported on.

"5. The Committee reserves the power of withholding the gratuity on the ground of insufficient merit, or of marking its sense of higher efficiency by increasing it.

"6. A gratuity, increasing according to the value of the Certificate, will be given to the master of the Adult Evening School in Union whose scholar is successful in any of the Society's Examinations.

"7. Applications must be made for the gratuity to the Society's Local Secretary before the 14th day of March."

The method that has been adopted of determining the amount of the gratuity, with a view to the assistance of the poorer localities, has been to allow 1s. for every scholar who has attended 80 hours, 6d. for every scholar who has attended above 60 hours but less than 80, and 3d. for every hour the school has been open.

The last report states that nine evening schools have received gratuities.

The Hants and Wilts Society has also suggested a plan for grouping together the libraries of a district, so as to form a Local Union, allowing of a mutual interchange of the books. This plan is carried out by the local secretary in each district, with the consent of the librarians, in the following manner:—

"The catalogues of the libraries in union are interchanged.

"A subscriber to any of the libraries in union is entitled to the use of the books in any other such library (except such as are not allowed to be taken out of the room), on sending the name of the book required to the librarian of his own library, on or before a certain day.

"Each librarian should collect and return at the end of the month the books received the preceding month, and forward a fresh list of those applied for. The carriage should be paid for out of the funds of the library receiving the books.

"No book is to be sent out that has not been six months in the library.

"No librarian is entitled to apply, on behalf of the subscribers to his library, for more than one volume for every ten volumes in the library he represents. Volumes not returned are counted as against the library applying, and a forfeit of 1d. per week is to be paid by the person detaining a volume over two months, through his librarian, to the library to which the book belongs."

The Society has had it in contemplation to promote the establishment of evening classes and schools under *itinerating* teachers, though this object has, as yet, been only very partially carried out.

The most important means, however, which the Society has employed for the furtherance of adult education, has been the establishment of examinations, which have now been in operation two years. These examinations are divided into four classes, the arrangements of the first two being for the present year as follows:—

"CLASS I.—*A*. An examination in any 3 lectures that have been delivered in the member's Institution within the last year. *B*. An examination in any subject taught in a class of which the candidate has been a member. *C*. In any 3 vols. on history, science, or geography, in the library of his Institution. *D*. In 3 subjects chosen by the Society, announced at each anniversary meeting. For 1858:—1. The History of England from 1377 to 1509. 2. The Hydraulic Ram and Press. 3. The Mountain System and River Drainage of Europe. *E*. In any three subjects or books chosen by the member and approved by the secretaries of the Society. 1st week in May.

"CLASS II.—*A*. A similar examination to that of a candidate pupil teacher. *B*. A similar examination to that of a pupil teacher at the end of the 1st year. *C*. A similar examination to that of a pupil teacher at the end of the 2nd year. *D*. A similar examination to that of a pupil teacher at the end of the 3rd year. *E*. A similar examination to that of a pupil teacher at the end of the 4th year. *F*. A similar examination to that of a pupil teacher at the end of the 5th year. *G*. A similar examination to that for a Queen's scholarship. *H*. A similar examination to that for a master or mistress. 1st week in May."

In these classes the Examinations are conducted by written papers, which are forwarded to the Institute of which the candidate is a member, and the papers are returned to the Examiners, with the answers, accompanied by a certificate, signed by one or more persons appointed by the president of the Institute to conduct the Examinations. This certificate is in the following form:—

"HANTS AND WILTS EDUCATION SOCIETY.

"Two hours are allowed for the annexed paper. The

answers are to be enclosed and sealed in the room were the Examination is held, and sent by post to

_____

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_____

"This Paper is to be returned with the answers, accompanied by the following certificate:—

"I hereby certify that I have been present during the two hours allowed for this paper, and that the enclosed answers are the answers of ,
without any assistance whatever, from books, notes, or otherwise.

"(Signed)
"
"

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The following are the principal conditions upon which, in the Hants and Wilts Society, candidates are admitted to examination:—

"1. Candidates must give early notice of their intentions to the Local Secretaries, or to the Secretaries of the Society, specifying their age, school, or Institute, and the class of examination they propose to undergo.

"2. Candidates must send in with the notice a testimonial, first, of good conduct; and secondly, of their fitness to undergo the examination they select, signed by the president and secretary, or two managers of their Institute or evening school.

"3. Candidates must be above fifteen years of age.

"4. The Examinations in class 1 are equally open to males and females. Those in class 2 are not open to pupil teachers, masters, or mistresses.

"5. Certificates will be given to all who pass the Examination satisfactorily; to which prizes of books, varying in value according to the value of the examination, will be added, where the examination has been of distinguished excellence.

"CLASS III. and CLASS IV. consist of the examinations of the Society of Arts and of delegates from the University of Oxford, and arrangements have been made by the Hants and Wilts Society to carry on preparatory examinations for both these classes. The Society is also prepared to give assistance towards the expenses of all those who hold the Society's certificates and are desirous of presenting themselves for examination in classes 3 or 4."

It will thus be seen that, while by means of the examinations in classes 1 and 2, the most elementary knowledge may obtain recognition, and the candidate be encouraged to further efforts, the Society affords facilities for those who desire to offer themselves as candidates at the examinations of the Society of Arts and of the University of Oxford, where more extended knowledge may be recognised and rewarded.

SOUTH KENSINGTON MUSEUM.

During the week ending 6th Feb., 1858, the visitors have been as follows:—On Monday, Tuesday, and Saturday, free days, 2,652; on Monday and Tuesday, free evenings, 2,171. On the three Students' days (admission to the public 6d.), 630; one Students' evening, Wednesday, 73. Total 5,526.

Home Correspondence.

EXAMINATIONS.—BRIGHTON MEETING.

SIR,—Observing in your report of the meeting at Brighton, on the 22nd ult., of a Provisional Committee of Institutions in Union with the Society of Arts to meet a deputation from that Society, with a view to the formation of a Local Board of Examiners for Institutions in this locality, that it was stated that no reply had been received from the invitation sent to the Hastings Mechanics' Institution, I beg to state that, from a letter received this morning from Mr. B. Phillips, of Brighton, I find the invitation was addressed to the Secretary of the Hastings Literary and Scientific Institution, and that, consequently, it never reached me. If it had, our Committee would, doubtless, have deputed some one to attend the meeting, as the principle of the Society's Examination meets their entire approbation.

I am, &c.,
JOHN BANKS,
Hon. Sec. Hastings Mechanics' Institution.

Hastings, February 8, 1858.

THE INK OF THE ANCIENTS.

SIR,—Looking over the paper of Mr. Underwood "On the History, &c., of Printing and Copying Inks," I observe that no mention occurs of a method supposed to be employed by the ancient Egyptians, for the preparation of their ink, described to me by the late Mr. Charles Hatchett, F.R.S., and, as the particulars may still have interest for the author of that paper and others, I venture thus late to trouble you with them.

Mr. Hatchett said it had only latterly been known to chemists that borax is a solvent to shellac, and that prior to the knowledge of this fact the constituents of the Egyptian ink had been a mystery. He then explained that by making a solution of shellac with borax, in water, and adding a suitable proportion of pure lamp-black, an ink is producible which is indestructible by time or by chemical agents, and which, on drying, will present a polished surface, as with the ink found on the Egyptian papyri. I made such ink, and proved the correctness of Mr. Hatchett's formula, if not its identity with that of ancient Egypt.

I am, &c.,
JOSEPH ELLIS.

Brighton, Feb. 9, 1858.

Proceedings of Institutions.

ROYSTON.—The general annual meeting of the Institute was held on Wednesday evening, 27th January, the Rev. R. Shaen in the chair. The secretary read the report, which states that a review of the past year exhibits signs of progress. The total income, including a balance in hand at the commencement, amounted to £107 3s. 7d. The total expenditure was £97 2s. 5d., leaving a balance now in the hands of the treasurer of £10 1s. 2d. The members and subscribers who were connected with the Institute during the whole or any portion of the past year, consisted of 11 Life Members, 6 Honorary Members, 213 Ordinary Members, and 64 persons who were admitted to the lectures by family or school tickets; giving a total of 294, an advance of 23 on the preceding year. Among the ordinary members, 92 belonged to the classes of mechanics, domestic servants, and young persons under 18 years of age; an increase of 35 on the previous year. Sixteen lectures and entertainments were given during the year:—1 by W. P. Hammond, jun., Esq., on "A Tour in Spain;" 2 by R. Hunt, Esq., F.R.S., on "Sermons in Stones" and "Books in the Running Brooks;" 2 by Geo. Dawson, M.A., on "De Foe" and "John Bunyan;" 1 by S. N. Davey, Esq., on "Thomas de Quincey;" 1 by the Rev. John B. Whiting, M.A., on "The Chinese Rebellion;" 1 by Messrs. Williams and Miss Bessie Williams, a Musical Entertainment; 1 by Messrs. T. W. Pickering, C. Dryden, Justyne, Richards, and Davis, an Elocutionary Entertainment; 2 by E. Wheeler, Esq., on "The Electric Telegraph;" 1 by the Rev. W. W. Harvey, B.D., on "Our Anglo-Indian Empire;" 1 by George Buckland, Esq., a Musical Entertainment, "What shall my Songs be to-night?" 1 by R. O'Hara, Esq., on "India;" 1 by Dr. J. C. Daniel, on "Sir Walter Raleigh;" 1 by the Rev. John B. Whiting M.A.—Indian Scenes, with Explanatory Remarks. O

these, six were gratuitous. During the past year 55 volumes were purchased and added to the library. Mr. Isaac Beale, the Librarian, states that the number of members making use of the library during the year was 128, and the total number of volumes issued was 3875. This is a considerable advance on the preceding year. 125 members subscribed to the Reading Room during the year; and the average number making use of the room each evening was rather more than 19. Chess and draughts have been provided for the use of the members of the reading room. Mr. John Fordham, Secretary of the Preliminary Savings Bank, states that the number of depositors was 259, and the amount deposited £154 3s., the average by each depositor being 11s. 6d. The amount drawn out was £56 0s. 3d. After the adoption of the report, the election of officers took place, the Right Hon. the Earl of Hardwicke being elected President. After passing several votes of thanks, the meeting separated.

WAREHAM.—An interesting and instructive lecture was delivered at the Town-hall in connection with the Mutual Improvement Society, on Friday evening, the 28th ult., by the Rev. Dr. Fletcher, of Wimborne, on "India," illustrated by maps and diagrams; W. H. Hatherley, Esq., in the chair. There was a good attendance, and every one seemed pleased. The musical friends of the Institution played some select pieces before and after the lecture.

WIRKSWORTH.—The fifth annual report of the Mechanics' Institution, presented to a general meeting of the members, held on Monday, the 28th day of December, 1857, when Mr. Cantrell, president of the Institution, occupied the chair, congratulates the members on the continued prosperity and success of the Institution. At the commencement of the year, the number of members was 126, and the committee have admitted during the present year five honorary life members, one honorary yearly member, and fifty-five ordinary members, making a gross total of 187. Against this the committee have to report the withdrawal of thirty-one from various causes, so that the number of members at this time is 156, showing an increase of 30 members during the year. During the year four lectures have been delivered gratuitously in connection with the institution, each of which was pecuniarily profitable to it. The following are the lectures:—"Poetry and the Poets of Derbyshire," by T. R. Potter, Esq.; "The Pendulum;" 1st—as a guage of Astronomical Time; 2nd—as a guage of Musical time; 3rd—as proving the oblate sphericity of the earth; and 4th—as determining (Foucauld's experiment) the earth's diurnal rotation, by the Rev. J. Edwards; "Chemistry; the non-metallic elements;" by the Rev. F. H. Brett; and "Greek, Roman, and English Comedy," by the Rev. J. Edwards. The library comprised a large number of volumes which were valueless for the purposes of the Institution, and the committee authorised the librarian to select therefrom such as were suitable, and dispose of the others. In consequence of this step, the library has been reduced in number, but is more available and suitable than heretofore. 99 volumes of new books have been obtained through various sources and added to the library. The present number of volumes belonging to the Institution is 829; and during the year no less than 1,077 volumes have been exchanged. The committee continued the evening school, established by their predecessors, and alluded to in the report for 1856, up to April last, under the superintendence of Mr. H. Marsden. It was then closed during the summer months, and re-opened early in October. The present number on the books as attending the classes is 33, and the average attendance is 18. The balance in the treasurer's hands is £21 10s. 7d. In consequence of the favourable results of the Festival of last year, the committee thought it desirable to hold one this year also. The president of the Institution again placed the disposal of his grounds at the service of the committee, and a horticultural exhibition was held, which proved successful.

MEETINGS FOR THE ENSUING WEEK.

TUES. Royal Inst., 3. Prof. Huxley, "On Animals and Plants compared physiologically."
Civil Engineers, 8. Mr. J. A. Longridge, M. Inst. C.E., and Mr. C. H. Brooks, "On Submerging Telegraphic Cables."
Pathological, 8.
Statistical, 8. Mr. Newmarch, "On the History of Prices in 1857."

WED. Society of Arts, 8. Prof. Crace Calvert, "On Recent Scientific Discoveries as applied to Arts and Manufactures."

THURS. Royal Inst., 3. Prof. Tyndall, "On Heat."
Philosophical Club, 5½.
Antiquaries, 8.
Chemical, 8. Mr. Mercer, "On Atomic Weights."
Linnæan, 8. I. Mr. Lubbock, "On the arrangement of the cutaneous muscles of the Larva of *Pygæra bucephala*." II. Mr. Macdonald, "On the probable metamorphosis of *Pedicularia* and other genera of *Gasteropoda*." III. Mr. Macdonald, "On the Anatomy of *Eurybia*."
Philological, 8.
Royal, 8½.

FRI. Geological, 1. Anniversary.
Royal Inst., 8½. Mr. E. Beckett Denison, "On some of the Improvements in Locks since 1851."

SAT. Asiatic, 2.
Royal Inst., 3. Prof. Bloxam, "On the Chemistry of the Elements which circulate in Nature."
Medical, 8.

PARLIAMENTARY REPORTS.

PRINTED SESSIONAL PAPERS.

Delivered on December 14, 16, 18, 19, 21, 22, 23, 24, 26, 30, 31, 1857. *January* 1, 5, 11, 12, 18, 29, *and February* 2, 1858.

Parl. No.
5. Pauper Lunatics (Scotland)—Return.
7. Oxford University—Copies of Statutes and Ordinances.
10. Ecclesiastical Commission (Ireland)—Report and Account.
4. Banks—Return.
8. Articles of Food—Return.
18. Netley Hospital—Reports.
22. Land Transport Corps—Copy of Instructions.
12. Flogging (Navy)—Return.
17. Flogging (Army)—Return.
23. China (Military Auditor)—Copy of Instructions.
9. Charterhouse—Copy of Report.
14. Freight of Specie—Return.
15. Public Parks—Return.
24. Common Law (Judicial Business)—Copy of a Letter.
16. East India (Revenue)—Return.
21. River Thames—Copy of Mr. Gurney's Report.
19. Australian Postal Service—Copy of Contract, &c.
20. Police (Counties and Boroughs)—Reports.
11. East India (Public Works)—Return.
2. Bills—Medical Charities (Ireland).
5. ——— Public Health Act (1848) Amendment.
Army Purchase Commission—Report of the Rt. Hon. Edward Ellice, &c.
Liverpool Compass Committee—First and Second Reports to the Board of Trade.
Galway Town Election—Report of Commissioners.
Colonial and other Possessions—Statistical Tables, Part 2.
Engineers Watt and Park—Paper relative to the Imprisonment of, at Salerno.
East India (Despatch of Troops)—Correspondence.
Decimal Coinage Commissioners—Lord Overstone's Questions, with Answers.
Trade and Navigation (1856)—Annual Statement.
Australia (Discovery of Gold)—Further Papers.
East Indies (Mutinies)—Appendix (A) to further Papers (No. 5).

FIRST SESSION, 1857.

125. General Index to Sessional Papers 1852—1857.

SECOND SESSION, 1857.

281. Public Income and Expenditure—Account.
329. Parliamentary Voters—Abstract of Return.
335. Accidents on Railways, &c. (Ireland)—Abstract of Return.
77 (A 3). Poor Rates and Pauperism—Return (A).
277. Lunatic Asylums (Ireland)—Report of Commissioners.
305. British Guiana—Return.
49 (7). Drade and Navigation Accounts (30th Nov., 1857).
224, 260 (1). Hudson's Bay Company—Plans referred to in the Report.
269 (1). Contracts (Public Departments)—Index to Report.
77 (A 4). Poor Rates and Pauperism—Return (A).
126. Civil Services, &c.—Detailed Statement of the Estimates.
252 (2). Hop Duties—Index to Report.
77 (A 5). Poor Rates and Pauperism—Return (A).
334. Convicts and Misdemeanants (Ireland)—Abstract of Return.
292. Railways—Return.
Delivered on 6th February, 1858.
28. National Gallery and British Museum—Return.
9. Bill—East India Loan.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Feb. 5, 1858.*]

Dated 8th December, 1857.

3038. William Jones Ward, Chorlton-on-Medlock, Manchester—Improvements in dyeing and printing textile fabrics and materials, and in apparatus connected therewith.

Dated 15th January, 1858.

68. John Macintosh, Aberdeen—Improvements in apparatus for the manufacture of articles of confectionery.

Dated 19th January, 1858.

86. Vital De Tivoli, 67, Lower Thames-street—An improved omnibus.

Dated 20th January, 1858.

95. Robert Martin, Glasgow—Improvements in machinery or apparatus for effecting the shipping of minerals in tidal situations.

97. William Muir, Strangeways, Manchester—Improvements in stands for letter copying presses and other small machines.

99. John Dyson, Edwin Wilkinson Shirt, and Henry Shirt, Tinsley Works, near Sheffield—An improved construction of spring for resisting sudden and continuous pressure.

101. Richard Archibald Brooman, 166, Fleet-street—Improvements in the preservation of animal and vegetable substances. (A communication.)

103. William Conisbee, King-street, Queen-street, Southwark-bridge-road—Improvements in printing machines.

Dated 21st January, 1858.

105. James Henry Wheatley, 15, Jacob's Well, Barbican, City—Improvements in printing machines.

106. William White, Adelaide-street, South Shields—Improvements in machinery or apparatus for making moulds or matrices employed in casting metals.

107. Thomas Ivory, Edinburgh—Improvements in steam boilers.

109. James Murdoch, 7, Staple-inn—Improvements in breaks for railway and other carriages. (A communication.)

110. Peter Wilson, Samuel Northall, and Thomas James, Birmingham—Improvements in locks and latches.

111. Edward Rawlings, Birmingham, and John Briden, Aston-juxta-Birmingham—A new or improved method of working stamps used for stamping or raising metals, and other such like purposes.

112. Henry Smith, Brierley Hill Iron Works, Dudley—An improvement or improvements in the manufacture of iron hurdles and fencing.

113. John Staite Brown, Cirencester—Improvements in mills for grinding corn or other substances.

114. William Clark, 53, Chancery-lane—Improvements in lubricating apparatus. (A communication.)

115. Hyacinthe Hermagis, Paris—Improvements in stereoscopes.

Dated 22nd January, 1858.

116. William Matthew Raine, 34, Bucklersbury—Purifying and increasing the illuminating power of gas.

117. William Blackett Haigh and Joseph Cheetham, Oldham—Improvements in valves for steam-engines and in superheating the steam.

118. James Brown, Coventry—Certain improvements in looms.

119. James Brown, Coventry—Certain improvements in Jacquard machines.

120. William Basford, Longport, Staffordshire—Improvements in kilns or ovens for burning or firing bricks, tiles, pipes, and pottery or earthenware, and in the mode of charging the ovens or placing or setting the articles that are to be fired therein.

121. Alfred Sterry, Gorwydd Colliery, Swansea—Improvements in safety lamps.

122. William Weild, Manchester—Improvements in machinery for winding yarn or thread on to bobbins, spools, cards, or other similar surfaces.

123. Thomas Walton Mellor, Ashton-under-Lyne—An improved apparatus for measuring water and other fluids.

Dated 23rd January, 1858.

124. Nicolas Augustin Drouet, and Pierre Philippe Le Coq, Paris—Improvements in treating chloride of sodium for obtaining therefrom certain useful products.

126. John Samwells, Dunstable, Bedfordshire, and Charles Henry Jones and Christopher Pickard, Leeds—Improvements in blocking and shaping hats, bonnets, and other coverings for the head.

127. John Gordon, 3, Railway-place, Fenchurch street—Improvements in machinery or apparatus for pulping coffee.

128. James Johnston, Paisley—Improvements in bonnets, caps, and other coverings for the head.

129. Charles Burn, Blomfield-crescent, Westbourne-terrace, Paddington—Improvements in the manufacture of iron cables and chains, which improvements are applicable to the manufacture of gold and other chains.

130. Jonas Craven, Bradford, and Wignall Hey and Charles Worsnop, Manningham, near Bradford—Improvements in actuating rotary shuttle boxes of looms.

131. Elijah Slack, Glasgow—Improvements in the treatment or preservation of potatoes and other amylaceous vegetable substances.

132. Joseph James Welch and John Stewart Margetson, Cheapside—An improved expanding or folding travelling bag or wallet.

133. Jean Jacques Huber, 14, Boulevart Montmartre, Paris—Improvements in the construction of brooches, bracelets, pins, and other articles of jewelry.

Dated 25th January, 1858.

134. Arthur Wall, East India road, Poplar—An improved lubricator for the moving parts of machinery.

135. George Edward Dering, Lockleys, Hertfordshire—Improvements in the permanent way of railways.

Dated 26th January, 1858.

136. Jeremiah Garnett, Ctley, and Peter Garnett, jun., Cleckheaton, Yorkshire—Improvements in the manufacture of felt.

138. Sir Henry Stracey, Bart., Blackheath-hall, Norfolk—An improved cartridge.

140. William Edward Newton, 66, Chancery-lane—A new or improved fabric intended principally as a substitute for leather. (A communication.)

142. Luigi Ferrari Corbelli, Florence, Tuscany—A new or improved process for obtaining aluminium. (Partly a communication.)

Dated 27th January, 1858.

146. Thomas Mottram, John Edwards, and Joseph Mitchell, Yorkshire—Rolling steel, iron, and other metals, and also for tilting the same for cutlery and other purposes.

WEEKLY LIST OF PATENTS SEALED.

February 5th.

2123. Daniel Jones Crossley.
2124. Ellis Rowland.
2127. John Parker.
2132. Thomas George Shaw.
2140. John Roberts, jun.
2157. Robert McAdam.
2180. John Abraham.
2235. François Jules Blanc.
2287. Lionel Gisborne and Henry Charles Forde.
2481. John Chubb.
2554. Athanase Victor Constant Regnauld.
2728. Johan Ernst Fridrich Luedeke.
2867. Alfred Vincent Newton.
2896. Philip Bettle.
2911. John Cope.
2984. Richard Hipkiss and William Olsen.
2987. Edward Clarence Shepard.
2996. Alexander Parkes and H. Parkes.
3103. James Broad.

February 9th.

2139. James Bertram and John Louis Jullion.
2143. Amherst Hawker Renton.
2144. Peter Augustin Godefroy.
2145. George Chambers.
2150. Thomas Hardcastle.
2151. Robert Wagstaff.
2152. Robert Wagstaff.
2153. William James Cantelo.
2170. Samuel Clift.
2177. John Buckley and Thomas Wrigley.
2197. Arthur Wall.
2198. Arthur Wall.
2205. William Hartley.
2263. James Goodwin and Andrew Boyd.
2271. Robert Aytoun.
2278. George Cumming.
2291. George Bell.
2325. William Edward Newton.
2333. William Sellers.
2395. Thomas Sidebottom Adshead and John Platt.
2413. Hugh Greaves.
2443. Pierre François Joly.
2485. Richard Watson.
2519. James Ward.
2737. William Clark.
2761. John Lawson.
2876. Thomas Richardson.
2893. Adolphe Ambroise Salomon-Cohen.
2491. Augustus Frederick Butler.
2966. Robert Tindall, junr.
3073. Joseph Parker.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

February 1st.

258. Edmund Clegg and James Leach.

February 3rd.

263. Godfrey Pattison.

February 4th.

265. John Henry Johnson.
286. William Warbrick and J. Walker.
320. Auguste Edouard Loradoux Bellford.

February 5th.

301. George Fergusson Wilson and George Payne.
316. George Hallen Cottam and Henry Richard Cottam.

February 6th.

302. Frederick Ransome.
331. Auguste Vallery.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
4051	Feb. 4.	Improved Configuration of a Drum	Rudall, Rose, Carte and Co.	20, Charing-cross.
4052	,, 6.	The Paragon Shirt	H. F. Lawes	Bristol.
4053	,, 8.	Royal Princess Corset Fastener	The Edinburgh Machine Sewing Company	Edinburgh.
4054	,, 8.	Churn Driving Apparatus and Stand	Thewlis and Griffith	Warrington.
4055	,, 8.	An Improved Piston for Valved Musical Instruments	Joseph Pimlott Oates	Erdington.